THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 50 Thursday, June 7, 1934 No. 929

PUBLISHED WEEKLY

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of

THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF

The Institute of British Foundrymen
The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

Institute of British Foundrymen

PRESIDENT: 1933-34.

Roy Stubbs, 56, Broadway, Cheadle, Cheshire.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.
Birmingham, Coventry and West Midlands: L. W. Bolton, 21-23, St. Paul's Square, Birmingham.
Sheffield: T. R. Walker, 33, Ladysmith Avenue, Nether Edge, Sheffield.
Scottish: J. Bell, 60, St. Enoch Square, Glasgow.
Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.
London: H. W. Lockwood, Stewarts and Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.
Newcastle-upon-Tyne: J. W. Eckford, 4, Mosley Street, Newcastle-upon-Tyne.
East Midlands: H. Bunting, 82, Otter Street, Derby.
West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.
Wales and Monmouth: J. J. McClelland, "Clydesdale," Dover Street, Bilston, Staffs.
Middlesbrough: P. A. Harper, Station Chambers, Middlesbrough.
Preston: P. Leyland, 6, Ashley Terrace, Farington, Lancs.
Lincoln: E. R. Walter, "Cavalla," Erntwell Road, Lincoln.
Burnley: J. Pell, 17, Mersey Street, Rose Grove, Burnley, Lancs.
Falkirk: H. McNair, 14, Seabegs Crescent, Bonnybridge, Scotland.

National Ironfounding Employers' Federation

President: J. Smith, Smith & Company (South Shields), Limited, Nile Street, South Shields.
Secretary: Harold G. Judd, C.B.E., 8, Frederick's Place, E.C.2.

The Institute of Vitreous Enamellers

President: Dr. J. W. Mellor, F.R.S., Stoke Technical College, Stoke-on-Trent.
Chairman: W. H. Whittle, Protector Lamp & Lighting Company, Limited, Eccles, near Manchester.
Hon. Secretary: Miss E. Christine Elliot, Davis Street, Cubitt Town, E.14.

Foundry Trades' Equipment and Supplies Association

President: R. H. Brackenbury, 13, Victoria Street, London, S.W.1.
Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association

President: W. E. Clement, Morfa Foundry, New Dock, Llanelly.
Secretary: E. J. Griffiths, 2, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION

The Registered Office and Laboratories of the B.C.I.R.A. at:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM
Telephone: Central 1885. Telegrams: CIRA
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332*)

Contents

	PAGE
The Iron and Steel Institute Meeting	355
More Haste Less Speed	355
Correspondence 356,	362
The Iron and Steel Institute	357
The British Non-Ferrous Metals Research Association	358
Annual Conference in Manchester, 1934	358
Mr. James Dyal	358
Studies on Cast Red Brass for the Establishment of a Basic Classification of Non-Ferrous Ingot Metals for Specification Purposes	359
King's Birthday Honours	362
Cast-Iron Scrap in the Open-Hearth Furnace ...	362
Studies in Cast Bronze	363
This Week's News in Brief	368
Trade Talk	368
New Companies	368
Contracts Open	368
Personal	368
Obituary	368
Publication Received...	368
Raw Material Markets	370

The Iron and Steel Institute Meeting

The spring meeting of the Iron and Steel Institute was noteworthy by reason of the acceptance of the Bessemer Medal by H.M. the King. Of the Papers, three lengthy and important reports were issued by various committees; one on blast-furnace practice will be read with interest by many ironfounders. It is a report of value, and will doubtless be followed by others. The work has been done by a sub-committee of the Iron and Steel Industrial Research Council. The publication of reports of the latter body through the Iron and Steel Institute will enhance the prestige of both bodies. Another report from the same source relates to refractory linings for blast furnaces, another useful document which will have its reactions on cupola lining. The third report, on corrosion, does not directly refer to cast metals, but there is no doubt that any advance which comes from the elaborate system of testing stations established will be readily applied to them.

The only report directly concerning cast iron was that presented by Mr. J. G. Pearce on elasticity, deflection and resilience. The author shows that the ordinary transverse deflection of a cast iron bar is in part elastic, since it disappears if the load is removed during testing, and in part plastic, since it remains if the load is removed during testing. If the test makes provision for separating these two, which, incidentally, is quite easily done in practice, it is found that the elastic part for the deflection is directly proportional to the load, irrespective of the nature of the iron, ferrite, pearlitic, austenitic, grey or malleable, and so on. Irons mainly differ in the value of the plastic part, or permanent set, and brittle irons have a low, and tough iron a high, set, relatively speaking. The author's main proposal is that, to get more consistent values of Young's modulus, or E, the formula used in its calculation should be based on the elastic part of the deflection at fracture, and figures are given showing how this differs from E calculated in other ways. Changes in deflection, and hence in E, with size and shape of bar and span are indicated, and finally it is suggested that the toughness of an iron, its resistance to impact, is proportional to the total resilience, or energy put into the bar to fracture, measured by the area under the curve of load and total deflection.

More Haste Less Speed

We recently spent a day at one of the largest quantity-production foundries in Great Britain, and were duly impressed by the speed of manufacture, the planning, the lay-out, the absence of "dead ends" and the cleanliness, but we imagined that we noted a certain weakness in the general organisation. Excessive speed has spread to the designing department. New plant was conceived, designed, installed and operated at too high a speed. This resulted, as it must invariably, in waste and delays at a time when a maximum of disturbance is caused. It brought back memories of the time when it was our duty to put electric furnaces into operation in various parts of Europe. At that time the war conditions were blamed for small but aggravating errors in design, in ordering up plant and in providing the necessary instruments of control.

There is a conception, due no doubt to excessive haste in the creation of new plant, that because an instrument weighs but a few pounds, the time for its manufacture is correspondingly short. There was, and is, an insufficient appreciation of the time demanded by pipe fitters and other members of the works maintenance staff to contribute their quota to the finished plant. Most of these troubles are due to the splitting-up of the designing amongst a number of individuals.

The only method of ensuring that new plant will be ready to time and that the incidence of snags will be reduced to a minimum, is to prepare a schedule at the earliest possible moment of every component to be made or purchased and every operation to be performed in connection with the provision of foundations, erection and starting up. This schedule will also include the supply of spare parts and adequate raw materials, the testing of the instruments and motors. The delivery and completion promises should be marked on the schedule, and as much notice as possible be given to the outside contractors to ensure that their specialists will be available at the requisite time. Contractors are not usually quantity-production firms, and their staff of specialists is necessarily of limited proportion. Trunk calls and telegrams do not constitute an adequate reason for erectors and specialists leaving one job in an incomplete condition to "oblige" (to quote the charring sisterhood) the large quantity-production firms. If the latter would give but one-tenth the amount of thought and provision to their department for designing for mass production as distinct from their routine designing and manufacturing, the wheels of industry would run more smoothly.

Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents]

Cupola Practice

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—It was good of Mr. Fletcher to write again so fully, and put forward further facts and opinions for the consideration of your readers. With your permission, I should like to make a few further comments and to summarise my own views on the matter.

Mr. Fletcher defines hearth gas, as "that formed between the horizon of the bottom (valved) tuyeres, and that, of the lowest row of

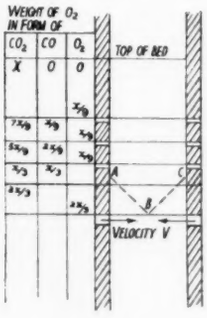


FIG. 1.

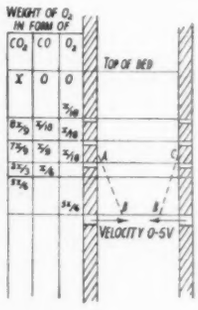


FIG. 2.

auxiliary tuyeres," and adds that the air additions from two or three rows of supplementary tuyeres progressively convert the CO in the rising hearth gases to CO_2.

In his letter, published in your issue of April 5, Mr. Fletcher gives the ideal gas in the lower tuyere zone as one in which equal weights of O_2 from the admitted air have burnt respectively to CO_2 and CO. If we assume that this composition is reached at the horizon of the lowest row of auxiliary tuyeres, then conditions in a balanced blast cupola correctly adjusted might be taken to be as shown in Fig. 1.

Such conditions indicate undoubtedly very high combustion efficiency and low oxidation from O_2.

Regarding oxidation by $CO_2+Fe \rightarrow FeO+CO$—the equation mentioned by Mr. Weeks in his letter published in your issue of March 8—the upper half of the bed would be the dangerous part; particularly so, as here the molten or semi-molten metal will be moving slowly. Where oxidation must be prevented, it would seem

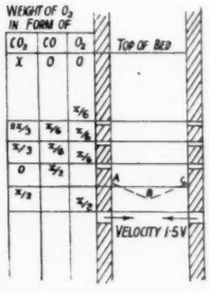


FIG. 3.

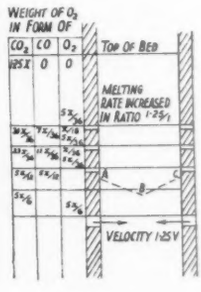


FIG. 4.

desirable to limit the attainable combustion efficiency, by allowing a higher CO content at the top of the bed.

It is of great interest to learn from Mr. Fletcher that the specific reactivities of cokes in general use vary but little from each other, and that size and hardness are of greater moment.

If now the bed of the cupola indicated in Fig. 1 be charged with smaller, and presumably more quickly burning coke, it is clear that with no tuyere adjustment the amount of O_2 in the form of CO at the first auxiliary tuyere level will be greater than $\frac{x}{3}$, and that this CO will not be completely burnt to CO_2 by the time the top of the bed is reached. By opening the lower tuyere valves conditions might be obtained approximating to those shown on Fig. 2. Again a very high combustion efficiency is shown, with gases at the first row of auxiliary tuyeres having a ratio of CO_2/CO of 3.14 by weight—a composition approached in practice (*vide* Mr. Fletcher's letter in your issue of April 5). Oxidation by CO_2 might be slightly more serious.

Fig. 3 indicates the possible conditions, if a large and presumably slow burning coke is charged, the air admission to the lower tuyeres being reduced by manipulation of lower tuyere valves. In this case, oxidation by O_2 in the upper part of the bed is likely to be more serious.

In all cases I have indicated that the changes between the tuyere horizons are such as to give maximum combustion efficiency. In practice, I doubt if the compensating factors would work quite so happily.

If the effect of increasing the total air supply with a faster burning coke (as for Fig. 2) without alteration of tuyere valves be now considered, conditions would be approximately as indicated in Fig. 4. These conditions are fairly like those shown on Fig. 1, though O_2 oxidation might be slightly worse.

In practice uniformity of gas composition over any horizon in the bed is not obtainable, and the effect of lower tuyere adjustment on gas distribution must now be considered.

To a fairly close approximation, the amount of air flowing through any tuyere will be proportionate to its area; and the tuyere—air velocity—which determines the degree of penetration of the blast, and the shape of the oxygen free zone on the hearth, will (*a*) vary directly with the total amount of air flowing, and (*b*) inversely as the total tuyere area.

The following table shows the figures for the cases considered.

Case as on Fig. No.	Total air flow.	Area of upper tuyeres.	Flow through valved tuyeres.	Area at valved tuyeres available for airflow.	Air velocity at valved tuyeres	Flow through auxiliary tuyeres.	Air velocity at valved tuyeres case I = V.
1	x	A	$^{2x}/_{3}$	2A	$^{2x}/_{3} \times \frac{1}{2A}$	$^{x}/_{3}$	V
2	x	A	$^{5x}/_{6}$	5A	$^{5x}/_{6} \times \frac{1}{5A}$	$^{x}/_{6}$	0.5 V
3	x	A	$^{x}/_{2}$	A	$^{x}/_{2} \times \frac{1}{A}$	$^{x}/_{2}$	1.5 V
4	$1.25x$	A	$^{5x}/_{6}$	2A	$^{5x}/_{6} \times \frac{1}{2A}$	$^{5}/_{12}{}^{x}$	12.5 V

It is clear that this particular method of control, viz., by means of valves on the lower tuyeres, will bring about great changes in the main tuyere air velocities, and so in the shape of the oxygen free zone in the bed, as indicated by the dotted lines ABC in the diagrams. That is, the desired optimum conditions of combustion in the hearth will not be obtained for various settings of the valves of the main tuyeres.

Control of the relative amounts flowing to main and auxiliary tuyeres by, for instance, variation of area of auxiliary tuyeres, affects the main-tuyere air-velocity to a very much smaller extent, and is therefore, in my opinion, greatly to be preferred. But, taking into account—(1) possible variations in size and hardness of coke; (2) the average conditions under which a cupola is worked; and (3) the complex variations which occur when the air distribution is changed—

I think it is highly desirable that the ordinary cupola should be equipped with tuyeres of fixed sizes; though during the experimental period of change to a better design, control valves of some sort may be desirable for use during the run-in period only.

In regard to the "hearth gases," I think that Mr. Fletcher will agree that the definition "representative of the gases formed in the region of the lower two rows of tuyeres"; where, according to the point chosen, the gas may consist either of O_2 and N_2 only, or almost entirely of CO_2 and N_2, is not of the same order of accuracy as the analysis given in his first letter; while, to revert to the question of the zone giving maximum melting-rate, it would seem that—(1) if more air is burned in the outer than in the inner half of the cupola, this is largely due to too soft a blast; (2) much heat is given to the metal above the coke bed, and I suggest that by gas and heat diffusion the temperature will be approximately uniform over any horizon in this part of the cupola; and (3) that since in the bed itself—as Mr. Fletcher points out—the temperature maxima follows the Belden curve, there is a greater depth at high temperature between melting zone and charging door near the centre than near the walls.

What follows is an attempt to summarise my views on some of the points discussed, relative to efficient melting.

(1) A deep and incandescent coke bed is necessary.

(2) In order to limit average depth of oxidising zone (O_2 oxidation), the lower tuyeres must be proportioned so that an excessive amount of air does not pass up the cupola near the walls.

(3) The greater proportion of the air supplied should enter at the lower tuyeres.

(4) Subsequent rows of tuyeres should be so spaced and proportioned that CO is present throughout the greater portion of the bed, being reduced as the gases rise through the bed. The amount of CO present should be determined on the basis of the conflicting factors:—(*a*) Combustion efficiency—No CO at top of bed, and (*b*) freedom from CO_2 oxidation—considerable CO throughout bed.

(5) For general use, it is desirable to use tuyeres of fixed size, and maintain reasonable control over size of coke in the bed and total air supply.

(6) Increased rate of melting should be obtainable by using relatively small coke, an increased air supply and increased spacings between rows of tuyeres.

(7) When oxidation is likely to be particularly detrimental, some decrease in combustion efficiency, with increase in CO content in bed, is desirable.

In conclusion, though I do not see eye to eye with Mr. Fletcher in regard to the virtues—and vices—of the balanced-blast cupola, I should like to acknowledge indebtedness to him particularly in regard to item 1 above.

Thanking him again for his letter, yours, etc.,

F. W. NEVILLE.

Vulcan Works, Blackfriars Road,
Manchester.

The Iron and Steel Institute

ANNUAL MEETING IN LONDON

The Annual Meeting of the Iron and Steel Institute was opened last Thursday at the Institution of Civil Engineers, Great George Street, Westminster, London, Mr. W. R. Lysaght, J.P., C.B.E. (President), in the chair.

Report of Council

The Council of the Institute, in their report, state that during the past year 91 new members and 11 associates were elected; six associates were transferred to membership, and seven members were reinstated. Sixty-one members resigned their membership during the year. The total membership of the Institute on the register at December 31, 1933, was accordingly as follows: Patron, 1; honorary members, 20; life members, 75; ordinary members, 1,778; associates, 45; a total of 1,919.

Referring to the deaths of 22 members during the year, the Council put on record their sense of the great loss sustained by the Institute through the deaths of Mr. W. H. Hewlett, Mr. George Hatton, C.B.E., and Mr. Val B. Stewart, C.B.E. Mr. Hewlett was first elected a member of the Institute in 1873, and may thus be counted almost as an original member; he joined the Council in 1905, became vice-president in 1914, and was elected an honorary vice-president in 1924. Mr. Hatton's membership dated from 1875, and he was first elected on the Council in 1920; he became vice-president in 1926, and at the time of his death was the senior vice-president of the Institute. Mr. Val Stewart had also served for eight years as a member of Council, but retired from that position in 1932.

Secretaryship. — At the end of July, Mr. G. C. Lloyd retired from the post of Secretary, which he had occupied since January, 1909, when he succeeded the late Mr. Bennett H. Brough. Mr. Lloyd has been succeeded as Secretary by Mr. Kenneth Headlam-Morley, B.A. (Oxon), who was formerly on the staff of Messrs. Dorman, Long & Company, Limited.

Andrew Carnegie Research Scholarships. — On the recommendation of the Carnegie Research Committee, grants were made by the Council in 1933 to the following candidates:—

W. BAUKLOH (Technical High School, Berlin-Charlottenburg), £100 for a study of the mechanism of the primary reactions of the oxides of metals with fixed carbon.

H. ELLISS (Sheffield University), £100 to carry out an investigation of the properties of iron and steel melted *in vacuo* and atmospheres of H_2, N_2, CO and CO_2.

E. L. FRANCIS (The University, Manchester), £50 to continue his work on wire-drawing problems.

B. JONES (University College, Cardiff), £50 in aid of a further investigation into the nitrogen-hardening of steels.

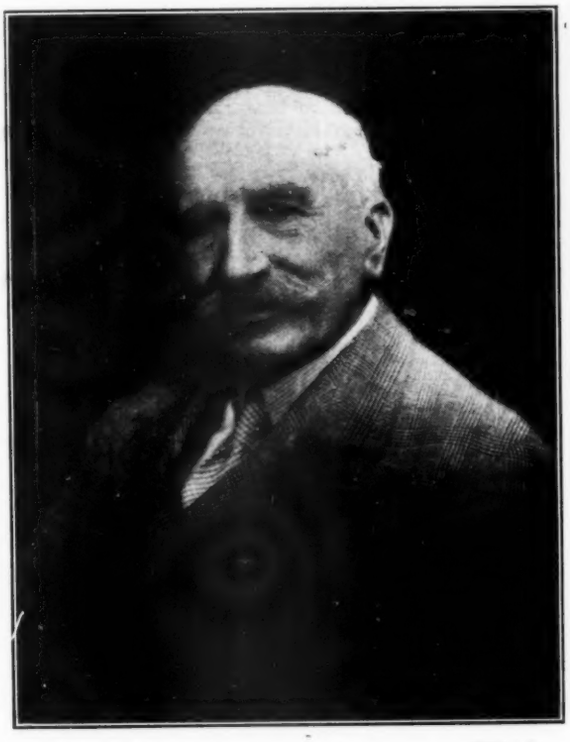
W. KLEINEFENN (Technical High School, Aachen), £50 to continue his investigations on various types of welded material and their behaviour under varying temperatures.

W. R. MADDOCKS (Royal Technical College, Glasgow), £100 in aid of an investigation of furnace slags, more particularly the ternary system FeO-MnO-SiO_2.

D. F. MARSHALL (Sheffield University), £100 to investigate the heat losses in blast-furnace practice.

Carnegie Gold Medal.—For the year 1933, the Carnegie Gold Medal was awarded by the Council to Mr. Brynmor Jones, M.Sc., F.I.C. (University College, Swansea), for his report on "Investigations into the Nitrogen-Hardening of Steels. Part II.—The Nitriding Properties of Some Chromium and Austenitic Steels at a Temperature of 500 deg. C.," published in Vol. XXII of the Carnegie Scholarship Memoirs.

Williams Prize.—In the year under review, the Williams Prize to the value of £100 was divided equally between the authors of the two Papers, "The External Heat Loss of a Blast-Furnace," by D. F. Marshall, and "Some Factors Leading to Greater Production from a Steel Furnace," by A. Robinson.



MR. W. R. LYSAGHT, J.P., C.B.E.
(President of the Iron and Steel Institute).

Changes on the Council.—Mr. Cyril E. Lloyd was elected a vice-president to fill the place vacated by Mr. W. R. Lysaght on his election to the Presidency. Mr. H. Spence Thomas was elected a vice-president in place of Mr. George Hatton, deceased. Mr. W. J. Brooke and Mr. P. B. Brown were elected members of Council to fill the vacancies caused by these changes.

In accordance with Bye-Law 10, the names of the following Vice-Presidents and Members of Council were announced at the Autumn Meeting as being due to retire at the Annual Meeting in 1934:—Vice-Presidents.—Mr. A. Hutchinson, Mr. John Craig, C.B.E., Mr. E. H. Saniter. Members of Council.—Mr. E. J. George, Mr. J. S. Hollings, Mr. W. J. Brooke, Mr. F. Clements, Mr. H. C. Bond.

No other members having been nominated up to one month previous to the Annual Meeting, the retiring members are presented for re-election.

Honours Conferred on Members

The Council desire to offer their congratulations to a number of members of the Institute on whom appointments of honour and academic distinctions have been conferred during the past year.

Mr. Lawrence Ennis has received the Order of Companion of St. Michael and St. George. Mr. A. Pourcel and Mr. E. V. Ronceray have been raised to the rank of Officers of the Legion of Honour, and Mr. Louis Grenet has been created a Chevalier of the Legion of Honour. On the occasion of the celebration in Paris of the Fiftieth Anniversary of the introduction into France of the Thomas and Gilchrist process for the manufacture of steel, the President of the French Republic conferred on Sir Charles Wright, Bt., K.B.E., C.B., the dignity of Commander of the Legion of Honour, and on Mr. F. W. Harbord, C.B.E., Officer of the Legion of Honour; Mr. G. C. Lloyd was made a Chevalier of the Legion of Honour.

Sir Robert Hadfield, Bt., F.R.S., has been created a Commendatore della Corona d'Italia. The Order of Commerce and Industrial Merit of the first class has been conferred on Mr. Percy R. Clark by his Majesty the King of Rumania.

Mr. W. R. Lysaght, C.B.E., President, has been elected an Honorary Member of the Chemical, Metallurgical and Mining Society of South Africa. Sir Robert Hadfield, Bt., F.R.S., has been elected an Honorary Member of the Russian Academy of Science, and Prof. Henry Louis has been appointed a Fellow of the Imperial College of Science and Technology. Prof. W. A. Bone, F.R.S., has been awarded the Gold Medal of the Society of Chemical Industry, in recognition of his researches into the mechanism of combustion. The following members have also been distinguished by the award of gold medals of other societies:—To Mr. J. W. Gardom, the Oliver Stubbs Gold Medal of the Institution of British Foundrymen; to Mr. E. V. Ronceray, the Gold Medal of the Société d'Encouragement pour l'Industrie Nationale; to Mr. S. N. Brayshaw, the Constantine Gold Medal of the Association of British Engineers; to Mr. G. H. Clamer, the Joseph S. Seaman Gold Medal of the American Foundrymen's Association for outstanding achievements in the metal-casting industry, and to Mr. D. J. McAdam, jun., the Longstreath Medal of the Franklin Institute.

Remarks by the President

The PRESIDENT said that he had not had an opportunity, since the corresponding period of last year, of meeting the members of the Institute. For the last five or six months he had been abroad, travelling in Australia, New Zealand and South Africa, and inspecting steelworks which had been erected there. Unfortunately for the industry in this country, he had found that the steelworks in Australia were extraordinarily efficient, and the works of the Broken Hill Company was one of the finest he had ever seen. The machinery was almost entirely modern. The ore was delivered at the furnaces at 8s. a ton, and they were making pig-iron at under £2 a ton. Their output was about 8,000 tons a week. They made plates, rails, wire rods (about 1,500 or 2,000 tons a week), sheet bars (about 1,700 or 1,800 tons a week), girders and beams, and all sorts of constructional iron. Their works was, he supposed, a model to the world. In addition to the Broken Hill works there were new works springing up called the Australian Iron & Steel Company. They had been making pipes of pig-iron for a number of

years, but they were now making steel, including rails and sections, and they were putting down sheet mills at the present time.

Then he had visited South Africa, and had seen the new works that were being erected at Pretoria. They had spent £4,000,000 on those already, and he understood they were going to spend another million. They were very fine works. He was informed that they were making pig-iron at not much over £2 a ton. They had got quite good ore, and very fair coke. Alongside they had wire works; they were going to roll wire rods and to supply the rails not only for the Transvaal but for the whole of the South African railways. Stewarts and Lloyds were erecting a works there. It was considered that in a very short time the whole of the heavy material required for the Transvaal would be produced at Pretoria.

Concluding, the President referred to the absence of Mr. G. C. Lloyd, who was not very well, and was not able to attend the meeting. He had not missed a single annual meeting ever since he had been Secretary.

SIR HAROLD CARPENTER (Hon. Treasurer) presented the accounts for 1933 and pointed out that the finances of the Institute had undoubtedly been adversely affected by the depression in the iron and steel industry during the last few years, the most serious drop being prior to 1932, the figures for which year benefited by a non-recurrent sum of £536 received on account of income tax. The economies which had been effected so far had been made without impairing the work of the Institute, but the Council considered that further reductions in expenditure could not be made without reducing the value of the Institute to members, and steps had been taken to avoid this.

The report and accounts were adopted.

Bessemer Gold Medal

The PRESIDENT reported that the Bessemer gold medal for 1934 had been graciously accepted by His Majesty the King. Sir Robert Hadfield, Sir Harold Carpenter and he, as President, had attended Buckingham Palace the previous day and handed the medal to His Majesty.

STOP PRESS FROM MANCHESTER

The Conference has opened on different lines from usual. See next week for full account. Mr. Roy Stubbs has been elected President and Mr. J. E. Hurst and Mr. Harry Winterton are now vices—we mean Vice-Presidents. Congratulations to all. Mr. Vincent C. Faulkner received the Oliver Stubbs medal and Mr. J. J. McLelland the meritorious medal inaugurated last year and presented to Mr. Finch, the founder of the Institute. . . .

Mr. Stubbs announced, after his Presidential Address, that the authorities of Sheffield University had decided to inaugurate a degree course in foundry practice in the Metallurgical Department, which is presided over with such distinction by Professor Andrew. . . .

Badges of office have been made available for the President for use at functions to which he is invited, for the President's wife and for the senior Vice-President. The official chain of office in these days of "off the gold standard" must be rather a worry for overworked Presidents. Mr. C. E. Williams, the immediate Past-President, has "donated," as the Americans say, the Vice-President's badge of office.

The British Non-Ferrous Metals Research Association

The 14th annual luncheon of the Association was held at the Savoy Hotel last Monday. It was presided over by the chairman of the Association, Mr. Thomas Bolton. Excellent speeches were made by Sir William J. Larke, K.B.E., and the Hon. R. M. Preston, D.S.O. Hints were given that the attitude of the Government towards research associations was changing, and there was some talk of Enabling Bills to ensure that every firm within certain industries would be forced to contribute towards the collective research work undertaken for its benefit.

In the Annual Report we find the following paragraph of distinct interest to our readers:—

Aluminium Castings

The work of this research during the year has defined the fundamental principles underlying gas-metal equilibria and the absorption and escape of gases from aluminium-alloy melts. Based on the results of the laboratory investigations, methods have been evolved for eliminating gases from aluminium alloys, and the conclusion appears to be justified that an effective, yet simple and practical, process is now available. Provisional patent protection has been obtained for the method, and large-scale tests on melts up to 600 lbs. have been made with the process in members' foundries. The results have been very satisfactory, and the total cost of the treatment is estimated to be less than one-tenth of a penny per lb. of metal. Further developments of the practical application of the process are anticipated.

There are, of course, many other researches of indirect interest, such as investigations into atmospheric corrosion of brightly-polished surfaces; spectrographic work; electro-deposition; galvanising; and the behaviour of alloys at high temperature. It is apparent from the Report that the Council appreciates to the full its contact through the Association's development officer, Mr. G. L. Bailey, with the Institute of British Foundrymen. The Council can rest assured that this contact is sincerely appreciated by the non-ferrous industry.

Annual Conference in Manchester, 1934

A total of £56 13s. has been subscribed to the Manchester Conference fund by the following members of the Foundry Trades' Equipment and Supplies Association, Limited:—Augusts, Limited; Bradley & Foster, Limited; Constructional Engineering Company, Limited; Wm. Cumming & Company, Limited; Foundry Plant & Machinery, Limited; General Refractories, Limited; Sterling Foundry Specialties, Limited; Thomas Wilkinson & Company, Limited; James Durrans & Sons, Limited; THE FOUNDRY TRADE JOURNAL; Fordath Engineering Company, Limited; and the Universal System of Machine Moulding & Machinery Company, Limited.

Lensbryte

On a recent visit to this office, Mr. W. Watson, of S. Pulzer & Son, Hatton Garden, London, E.C.1, presented us with a moulded tubular case containing "Lensbryte" for cleaning spectacle lenses. Our glasses will in the future emulate the brightness of those worn by a prominent North-West Lancashire foundry manager. We suggest that it would be well worth while for the managements of large foundries to supply their furnacemen, fettlers and welders with this material, as it is bound to have a beneficial influence on the character of the work turned out. Lensbryte is stated to prevent steaming and fogging, and because of this property it was used by the 1933 Mount Everest Expedition.

Mr. James Dyal

FIFTY YEARS WITH THOS. W. WARD, LIMITED

Mr. James Dyal, local director of Thos. W. Ward, Limited, Albion Works, Sheffield, has just completed fifty years' service with the firm. He entered the employ of the late Mr. T. W. Ward in 1884, who at that time had a coal office at the Corn Exchange and coal depôts at Park Station and Pond Street Station. After twelve months' service Mr. Dyal was sent to take charge of the Pond Street Depôt, and a year later he went to the little scrap depôts in Savile Street, adjoining the site on which has risen the famous Albion Works. By the time he had reached his majority Mr. Dyal had become exceedingly useful and was sent far afield to stimulate sales and promote business for the firm, attending dockyard and other auction sales and negotiating the purchase and sale of scrap and obsolete plant at ironworks in Cumberland, Staffordshire and various parts of the country.

Since that time he has travelled hundreds of thousands of miles in the British Isles and on the Continent in pursuit of business, and must be one of the most travelled men in the city. Mr. Dyal has generally been connected in some way with the negotiations for the dismantling of works and ships which have been undertaken on such a gigantic scale by Messrs. Thos. W. Ward, Limited, and during the last fifty years he has acquired a vast store of knowledge pertaining to the iron, coal, steel and allied industries.

The sagacity and urbanity of Mr. Dyal is proverbial, but he was once caught napping, as he is the man who ordered a cab at Weston-super-Mare to drive him to the Steepholme Forts for the purpose of inspecting guns which the Navy had offered for disposal. The cabby's reply is unprintable, as the forts are seven miles from land in the Bristol Channel.

Mr. Dyal's jubilee of service has been synonymous with the expansion and progress of the famous undertaking which employs him. When he commenced his career the business of the firm was mostly local and the commodities covered were coal, scrap and pig-iron, the latter sometimes being sold to the malleable-iron casters in 2-cwt. lots.

In those days the iron and scrap merchants who did big business with the railway companies, ironworks, etc., wore silk hats and white waistcoats, whilst the man who had just his horse and cart would be called a dealer or broker.

Mr. Dyal has a wonderful collection of humorous stories acquired during his world-wide travels and intercourse with personages great and small in industrial and commercial circles, and he is not averse to telling a story against himself. His chief recreation is golf, and he is a vice-president of the Lees Hall Golf Club.

British Industries Fair, Birmingham Section

The following are among those who have been reappointed to the Board of Management of the Birmingham Section of the 1935 British Industries Fair:—Mr. G. Philip Achurch, of Messrs. Parker, Winder & Achurch, Limited; Mr. John Belliss, of Messrs. Belliss & Morcom, Limited; Mr. Peter F. Bennett, O.B.E., J.P., of Messrs. Jos. Lucas, Limited; Mr. J. F. Davies, of Messrs. Radiation, Limited; Mr. C. E. Greener, of Messrs. W. W. Greener, Limited; Mr. C. Holland Harper, of Messrs. John Harper & Company, Limited; Mr. H. H. Humphries, O.B.E., City Surveyor and Engineer; Mr. E. J. Jennings, City of Birmingham Electric Supply Department; Mr. Thomas J. Kennedy, of Messrs. B. Mason & Sons; Mr. T. R. Martin; Mr. W. P. G. S. Pulzer & Son, Hatton Garden, London, E.C.1, Limited; Mr. J. F. Parker, of Messrs. British Rolling Mills, Limited; Mr. R. C. Rodgers, of Messrs. Buncher & Haseler, Limited; Alderman H. J. Sayer, J.P., of Messrs. Jos. Lucas, Limited, and Mr. A. W. Smith, Secretary of the City of Birmingham Corporation Gas Department. Mr. Thomas J. Kennedy has been elected President of the Birmingham Chamber of Commerce.

Studies on Cast Red Brass for the Establishment of a Basic Classification of Non-Ferrous Ingot Metals for Specification Purposes*

By C. M. Saeger, Junr.†

[AMERICAN EXCHANGE PAPER.]

Abstract

An investigation was sponsored by the Non-Ferrous Ingot Metal Institute at the Bureau of Standards to collect data to be used in the simplification of the number of compositions of copper-base ingot metals. The present research is restricted to red brass, having the nominal composition of 85 per cent. copper and 5 per cent. each of tin, zinc and lead.

A comparison was made of the alloys prepared from virgin and remelted metal with four distinct types of test-bars cast at temperatures from 1,040 to 1,260 deg. C. The results for tensile strength, Brinell hardness, electrical resistivity and density divided the test-bars into three classes:—(1) bars from chill ingots; (2) bars from ingots obtained by the "immersed-crucible" method, and (3) sand-cast bars. There were only slight variations in the values obtained for any type of bar cast from virgin or remelted metal. The shrinkage and the running properties of the alloy were also determined. The metallographic structure of the bars poured at 1,205 and 1,260 deg. C. led to the conclusion that, in general, a marked columnar structure is accompanied by inferior physical properties. Pronounced non-uniformity of structure was found in one type of sand-cast test-bar. Microscopic examination showed that sand-cast bars poured at high temperatures were subject to high stresses during the cooling, and had inferior physical properties. An expansion of the alloy occurred immediately after solidification.

In the second phase of the work the separate effects of sulphur and iron were studied. Casting at a high temperature lowered the physical properties more than did the addition of sulphur up to 0.1 per cent. The addition of iron up to 0.6 per cent. improved all of the physical properties of this brass with the exception of the electrical resistivity. The running properties were improved and the shrinkage was unchanged by the addition of either sulphur or iron.

The co-operative investigation is conducted at the Bureau of Standards by Mr. H. B. Gardner, a Research Associate for the Non-Ferrous Ingot Metal Institute, under joint direction of the Bureau and an Advisory Committee, appointed by the Institute, consisting of Dr. G. H. Clamer, President, The Ajax Metal Company, Philadelphia, Pennsylvania, Mr. F. L. Wolf, Chief Engineer and Technical Superintendent, Ohio Brass Company, Mansfield, Ohio, and Mr. J. W. Bolton, Metallurgist, The Lunkenheimer Company, Cincinnati, Ohio. This advisory committee has aided considerably, especially when the commercial aspects of the problem were involved. This Paper shows a type of research conducted at the Bureau of Standards in co-operation with industry to bring about simplification of standard specifications.

The author wishes to express his appreciation to Mr. H. B. Gardner, Research Associate, who made the tests and correlated the data contained in this Paper.

INTRODUCTION

A Special Committee on Promotion of General Use of Specifications for Copper Alloys in Ingot Form was organised by the American Society for Testing Materials in 1929. This committee, consisting of representatives of producers and consumers of copper-base ingot metals, had for its purpose the study and promulgation of the use of specifications for copper alloys in ingot form and to recommend to the Society such revisions in American Society for Testing Materials Specifications affected by these studies indicating the desirability towards reducing the number of specific non-ferrous ingot-metal alloys in commercial use.

Producers of non-ferrous ingot metals organised an institute, known as the Non-Ferrous Ingot Metal Institute. Through the co-operative efforts of the members of this Institute with the American Society for Testing Materials and other technical bodies definite progress has been made toward the standardisation of the non-ferrous alloys in use. As a result of a survey made, it was found that over 600 so-called common alloys were in use, and in addition many special alloys that are usually classed as high strength alloys. Tentative specifications have been promulgated and approved by the American Society for Testing Materials covering twenty non-ferrous alloys. It is believed that these, to a very large degree, may be used in place of the more than 600 now in use. Steps along educational lines will be necessary in order to make this work useful and effective. It is, of course, not believed that the industry will in five or ten years from now be producing only 20 non-ferrous alloys, but at least a goal has been set and constructive efforts should be made to approach it as closely as possible. It has been found that there are 40 different specifications for one of the most widely-used alloys of the industry, namely, 85 per cent. copper, 5 per cent. tin, 5 per cent. lead, 5 per cent. zinc. The variation between specifications is in all cases slight, either in allowed tolerances of the main constituents or in the impurity content, namely, nickel, sulphur, phosphorus, iron, antimony, etc. It appeared in this case that these forty specifications could probably be replaced by one.

MR. C. M. SAEGER, JUNR.

The Non-Ferrous Ingot Metal Institute has been instrumental in bringing about co-operative arrangements with the Bureau of Standards, whereby technical research is now being conducted at this Bureau for the purpose of providing additional and better information regarding copper-base casting alloys than is at present available.

SCOPE OF INVESTIGATION

In the tentative programme, red brass of the nominal composition, 85 per cent. copper and 5 per cent. each of zinc, tin and lead, which is one of the most widely-used commercial alloys, was selected as the first alloy to be studied.[1] The important variables include the form of the test-bars the method of casting them, the pouring temperatures, any possible differences between virgin metal and remelted metal, and the effects of definite amounts of known impurities. The effects of these factors upon the physical properties are summarised in this Paper.

Pouring temperatures of 1,040 deg. C., 1,095 deg. C., 1,150 deg. C., 1,205 deg. C. and 1,260 deg. C. were used in the study of virgin metal, remelted metal and the effect of sulphur. For the effect of iron, pouring temperatures of 1,065 deg. C., 1,150 deg. C. and 1230 deg. C. were used. The following properties were determined in sequence on each bar: Electrical resistivity, tensile properties, density and Brinell hardness. In addition, the shrinkage from above the maximum pouring temperature to room temperature, and the running properties at each of the pouring temperatures were determined. Metallographic examinations of the structures were also made.

MATERIALS AND METHODS

Materials

When the virgin metals used for making the alloy were analysed chemically, the only impurities found that might have any real significance were: 0.0052 per cent. of iron in the copper; 0.01 per cent. of iron in the zinc; 0.016 per cent. of iron and 0.12 per cent. of bismuth in the lead; and 0.023 per cent. of iron in the tin. The alloys were made up in heats varying from 80 to 100 pounds, and each constituent metal was weighed to within 1 per cent. The term "remelted metal" is used throughout the Paper to refer to the 85-5-5-5 alloy which was made from virgin metals, cast into ingot form, remelted and recast into test-bar moulds. The extreme range of composition as determined by analysis of the various heats was as follows, although in most of the heats the variations were much smaller. The slightly larger variation in zinc content, especially in the remelted metal, was caused by the greater volatility of the zinc:—

Metal.	Copper.	Tin.	Lead.	Zinc (by diff.).
	Per cent	Per cent	Per cent	Per cent
Virgin	84.52—85.56	4.91—5.26	4.80—5.28	4.64—5.21
Remelted	84.45—86.06	4.91—5.23	4.77—5.25	4.50—5.42

"Stick sulphur" and a copper-iron "hardener," which contained 52 per cent. of iron and was prepared from virgin copper and commercial open-hearth ingot iron, were used in preparing alloys containing sulphur and iron respectively.

Moulding, Melting and Pouring

Green-sand moulds were prepared from grade 00 Albany sand. A permeability number of 12 to 16 (American Foundrymen's Association units), a compressive strength of 5 to 7 lbs. per sq. in. and a moisture content of 6 to 6.5 per cent. were maintained throughout in preparing the sand for the moulds.

* A Paper read before the Annual Conference of the Institute of British Foundrymen now being held at Manchester. This publication has been approved by the Director of the Bureau of Standards of the U.S. Department of Commerce.

† Physicist, U.S. Bureau of Standards, Washington, D.C.

The metal was melted in a high-frequency induction furnace of the "lift-coil" type in a double-wall clay-graphite crucible. Each melt was heated to a temperature of 56 deg. C. higher than the temperature at which it was to be poured. A double-wall crucible was used to

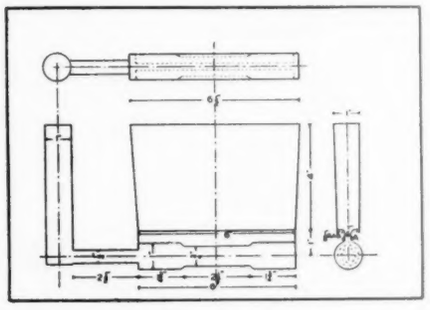


FIG. 1.—SAND-CAST TEST-BAR DESIGNATED AS THE "FIN-GATE" TYPE.

The thickness of the web, A, was varied as follows: $\frac{1}{8}$, $\frac{3}{16}$ and $\frac{1}{4}$ in.

minimise the drop in temperature during the pouring. The greatest difference in pouring temperature between the first and last of a series of test-bars from one heat poured at 1,040 deg. C. was 5 deg., and was approximately twice as great at 1,260 deg. C.

The sulphur additions were made by placing the necessary amount of stick sulphur, as deter-

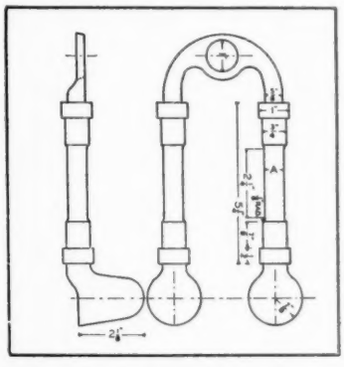


FIG. 2.—SAND-CAST TEST-BAR DESIGNATED AS THE "END-GATE" TYPE.

In cast-to-size bar, A = 0.505 in. In machined-to-size bar, A = 0.625 in. Poured uphill at an angle of 7 deg. with a 1-in. round pouring gate 5 in. high.

mined by analysis of preliminary melts, in a perforated graphite container, which was submerged in the molten metal until all agitation resulting from the reaction of the sulphur with the metal had ceased. In making an addition of iron, the copper-iron hardener was added just before the charge was completely melted. Sub-

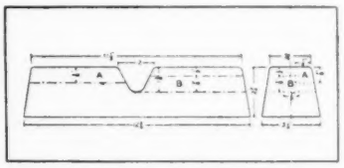


FIG. 3.—POSITION OF TEST-BARS IN THE CHILL-CAST INGOT.

A, Two-side Chill; B, No-side Chill.

sequent analysis of the alloys showed that in every case the content of sulphur or iron was within 0.05 per cent. of that desired.

Types of Test-Bars

Two forms of sand-cast bars, a chilled ingot, and ingots obtained by immersing a graphite crucible beneath the surface of the molten metal were made from each heat.

Fin-Gate Sand-Cast Bar.—This type of test-bar, often designated as the Webbert bar, is shown in Fig. 1. Its use is required in the specifications of the American Society for Testing Materials for brass castings.[2] Test specimens each having a web thickness of $\frac{1}{8}$, $\frac{3}{16}$ or $\frac{1}{4}$ in. respectively were used in the study of virgin and remelted metal, whilst specimens having a web thickness of $\frac{1}{4}$ in. were used in the study of the effect of sulphur and iron.

End-gate Sand-cast Bar.—A characteristic feature of this type of casting, shown in Fig. 2, is the absence of the heavy riser which tends to retard the cooling of the test-bar. This method furnished two bars poured under identical conditions which were used to study the "skin effect" by comparing the properties of bars cast to size with those machined to size. This type

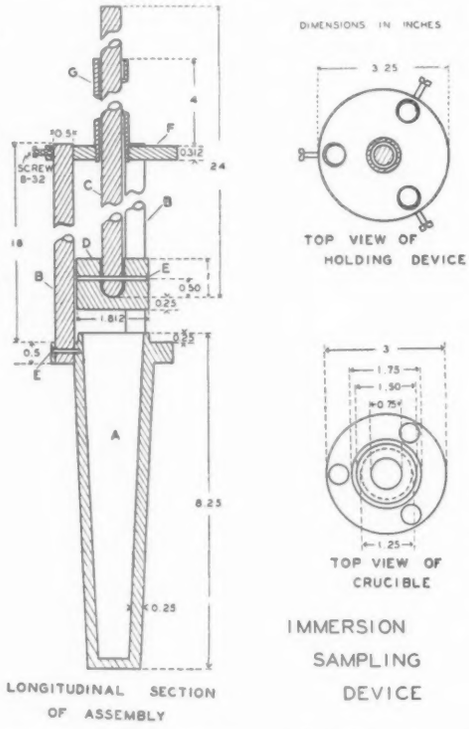


FIG. 4.—DEVICE FOR OBTAINING TEST-BARS BY THE IMMERSED-CRUCIBLE METHOD.

All parts were made of graphite. The tightly closed crucible, A, of known volume, was immersed beneath the surface of the molten metal and allowed to come to the temperature of the metal. The top, E, was then raised by means of the rod, C, and the crucible was filled. The cover was then replaced and the crucible containing the sample of metal was removed, placed in a dry-sand mould and allowed to cool to room temperature. The ingot was used in the determination of shrinkage as well as in other tests.

of bar has been used with pronounced success in commercial foundry work on non-ferrous alloys.[3]

Coupon from Chill-cast Ingot.—Two specimens were cut from each chill-cast ingot as shown in Fig. 3. One specimen was taken from that portion of the ingot which included two adjacent chill faces and the other from the portion farthest removed from the chill faces. These have been designated as "two-side chill" and "no-side chill" respectively.

Coupon from "Immersed-Crucible" Ingot.—This method of obtaining a test-bar consists essentially in withdrawing a sample of metal by means of a graphite crucible submerged beneath the surface of the liquid metal, as illustrated in Fig. 4. The method permitted the sampling of any heat without contamination that may be caused by the moisture of sand moulds. The "gassing" of metals and the possible source of such contamination are of interest to the foundry industry. The method also permitted a comparison between metal as ordinarily cast and the same metal that was not subjected to pouring and to mould conditions. Immersed-crucible samples were taken from each crucible of metal before the other forms of test-bars were cast. The ingot thus obtained was used to furnish data

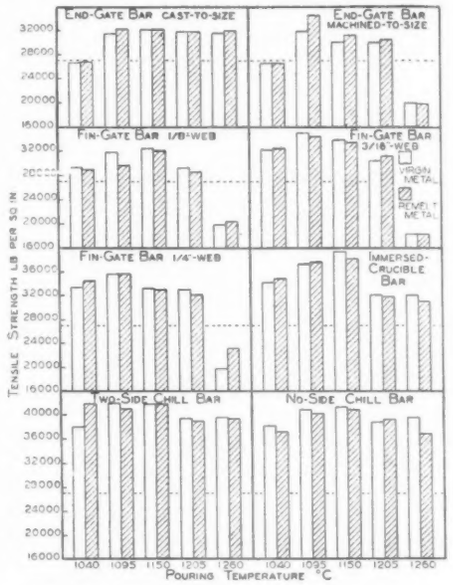


FIG. 5.—RELATION BETWEEN THE TENSILE STRENGTH AND POURING TEMPERATURE OF TEST-BARS MADE FROM VIRGIN METAL AND REMELTED METAL.

The minimum tensile strength for this alloy (A.S.T.M. Designation B30-32T) is shown by the broken line.

on the shrinkage of the liquid metal, after which it was machined to a conventional test specimen.

Measurement of Tensile Strength

The tensile properties were determined with an Amsler universal testing machine of 22 tons capacity, the load being applied uniformly with a rate of travel of the moving head of 0.1 in. per min. The test specimen used was 0.505 in. in diameter, with threaded ends and a 2-in. gauge length.

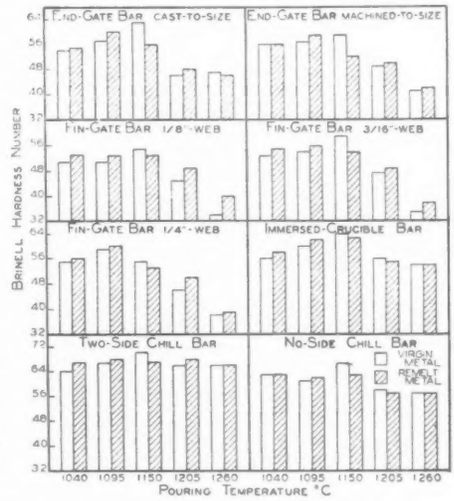


FIG. 6.—RELATION BETWEEN THE BRINELL HARDNESS AND POURING TEMPERATURE OF TEST-BARS MADE FROM VIRGIN METAL AND REMELTED METAL.

The reported results are the averages of duplicate determinations, usually on bars from the same heat. In most cases the tensile strengths of the duplicate bars agree within about 1,000 lbs. per sq. in. (about ± 3 per cent.), although there were a few larger variations. In such cases the higher values were accepted as being more authentic. Observed differences of

less than 1,000 lbs. per sq. in. are probably not significant.

Measurement of Shrinkage

The shrinkage of the alloy from a temperature of 1,315 deg. C., which exceeded the highest pouring temperature used, 1,260 deg. C., to room temperature was determined by the method described by Saeger and Ash.[4] It included the determination of the shrinkage (*a*) of the liquid metal, (*b*) during solidification and (*c*) in the solid state.

Measurement of Running Properties

The running properties of the alloy were studied by the method described by Saeger and Krynitsky,[5] which consists essentially in casting in a green-sand mould a small spiral strip of uniform parabolic cross-section. The length of the spiral is taken as an indication of the relative flowing properties of the metal under the conditions used.

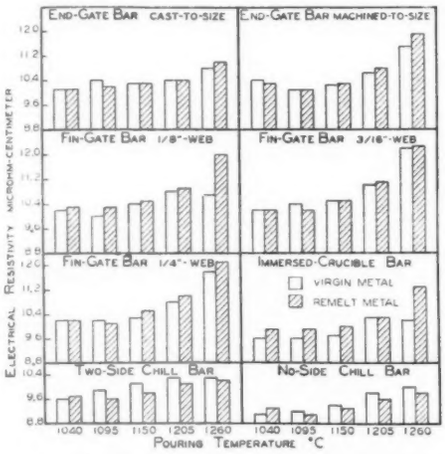


FIG. 7.—RELATION BETWEEN THE ELECTRICAL RESISTIVITY AND POURING TEMPERATURE OF TEST-BARS MADE FROM VIRGIN METAL AND REMELTED METAL.

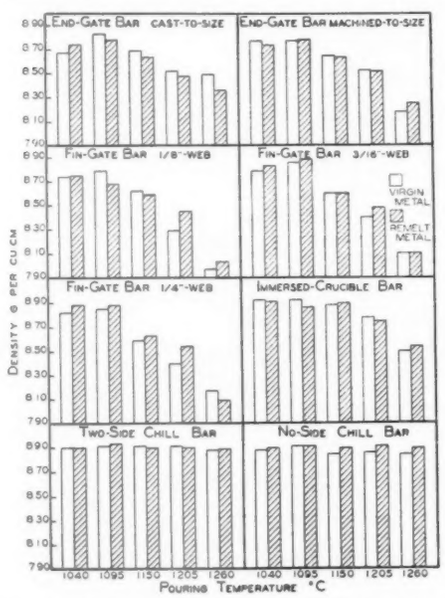


FIG. 8.—RELATION BETWEEN THE DENSITY AND POURING TEMPERATURE OF TEST-BARS MADE FROM VIRGIN METAL AND REMELTED METAL.

RESULTS AND DISCUSSION

For purposes of discussion the investigation may be divided into two parts: (1) the properties of the alloy made from virgin metal and from remelted metal, and (2) the effects of small percentages of sulphur or iron on these properties.

Virgin Metal and Remelted Metal

Tensile Strength.—In Fig. 5 are presented the data obtained for ultimate tensile strength. For each type of test-bar maximum tensile strengths were obtained at pouring temperatures of 1,095 and 1,150 deg. C. A marked drop in tensile strength was observed for the machined sand-cast specimens poured at 1,260 deg. C. No pronounced beneficial "skin effect" on cast-to-size specimens was observed except for bars cast at 1,260 deg. C.

On the basis of tensile strength, the various types of test-specimens may be arranged in three groups. The highest tensile strength was obtained on specimens cut from the chill-cast ingots. Next in order were those cut from the ingots made by the immersed-crucible method. The sand-cast bars, except those cast to size, were uniformly lower in tensile strength. No significant differences were noted between the virgin and the remelted metal in the same form of test-bar.

Brinell Hardness.—Brinell-hardness determinations were made on one of two parallel flat faces, $\frac{1}{8}$ in. in width, machined on the sides of the threaded portions of the broken test specimen. Each result shown in Fig. 6 is the average of three determinations. The results for Brinell hardness show the same general trend as do the corresponding values for tensile strength.

Electrical Resistivity.—The determination of electrical resistivity was made on the specimens used subsequently for tensile tests. These determinations[6] were made according to the procedure recommended by the American Society for Testing Materials.[7] The results, presented graphically in Fig. 7, show that the specimens having superior tensile strength and hardness invariably had lower resistivities. The resistivity increased decidedly as the pouring temperature was increased above 1,150 deg. C. This change in resistivity was more uniform for the remelted metal than for the virgin metal.

Density.—The density was determined on the ends of the broken tensile test specimens by the conventional method of displacement of water. The results are given in Fig. 8. No marked differences in density between the virgin metal and the remelted metal were found. All of the sand-cast bars showed a decided decrease in density as the pouring temperature was increased. The densities of specimens from the chilled ingots, which were uniformly higher than those of the sand-cast bars, were independent of pouring temperature. The density of specimens obtained by the immersed-crucible method for pouring temperatures of 1,205 deg. C. and above was intermediate between the corresponding values for the chilled ingot and the sand-cast bars. The maximum density was obtained in practically all cases with a pouring temperature of 1,095 deg. C.

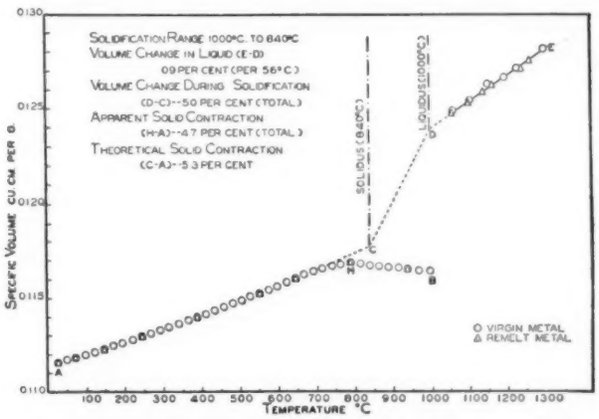


FIG. 9.—SHRINKAGE OF RED BRASS FROM 1,315 DEG C. TO ROOM TEMPERATURE.

Shrinkage.—The shrinkage of the liquid metal (E—D, Fig. 9) expressed in terms of the changes in specific volume was determined by the immersed-crucible method. Data on the shrinkage of the solid metal (C—A, Fig. 9) were obtained by direct observations of the change in length with change in temperature of a special sand-cast rectangular bar. To determine the shrinkage during solidification (D—C, Fig. 9), it was necessary to determine the solidus, C, and the liquidus, D, for this alloy. By thermal analysis, an average value of 840 deg. C. was obtained for the liquidus and of 1,000 deg. C. for the solidus. The difference between the specific volumes corresponding to these two temperatures is designated as the shrinkage of solidification. No significant differences in shrinkage were observed between alloys made from virgin metal and from remelted metal.

(*Continued on page 370*)

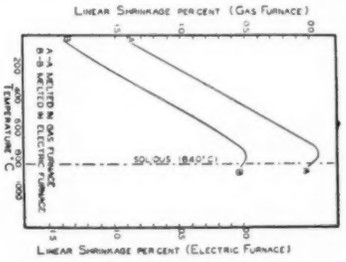

LINEAR SHRINKAGE PER CENT (GAS FURNACE)
A-S MELTED IN GAS FURNACE
B-S MELTED IN ELECTRIC FURNACE
TEMPERATURE °C.
LINEAR SHRINKAGE PER CENT (ELECTRIC FURNACE)

FIG. 10.—LINEAR CONTRACTION OF RED BRASS FROM SOLIDIFICATION TO ROOM TEMPERATURE.

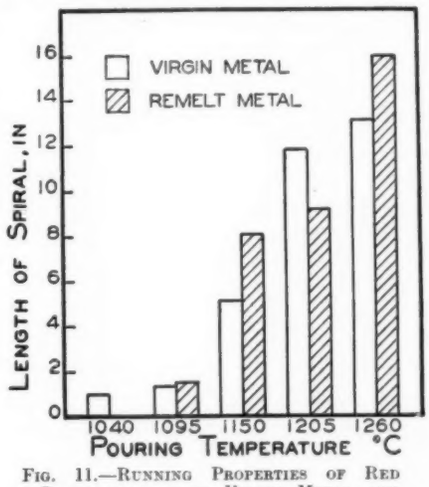


FIG. 11.—RUNNING PROPERTIES OF RED BRASS MADE FROM VIRGIN METAL AND REMELTED METAL CAST IN GREEN-SAND MOULDS.

Correspondence

[*We accept no responsibility for the statements made or the opinions expressed by our correspondents.*]

Malleable Specifications

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—We should welcome the opportunity of commenting on your Editorials of March 29 and April 12 entitled "Malleable Specifications."

The statement quoted from the *Resumé* of the work of the Malleable Iron Sub-Committee of the Institute of British Foundrymen presented to the Newcastle Conference, that the "Standard set is low, easily attained and often exceeded . . . this standard should be re-examined and possibly raised," was made in the light of long discussion, and cannot properly be considered except in conjunction with the five other points made regarding Standard Specifications. In the conclusion to the above Paper, it is stated "that this Resumé chiefly contains suggestion of matters which are worthy of attention." And until these matters, which are outlined in the seven points (in the second tabulation) are finally settled on sound experimental evidence, it is injudicious to dogmatise on the present position.

There are makers of both whiteheart and blackheart malleable regularly supplying material which appreciably exceeds the requirements of the existing B.S.I. specifications 309 and 310.

We fully realise the position of the manufacturer of thin-walled whiteheart malleable castings when called upon to meet the existing specifications. This fact is apparent from a careful reading of the Resumé presented at the Newcastle Conference. The Malleable Cast Iron Sub-Committee has investigations in progress which it is confidently expected will do much to clarify the position.

We suggest that "some confusion of thought" is shown in the two Editorials in question, in that the first article deplores the suggestion of raising the specification, but the second says that by the time the higher specifications are ready maybe the producers will be able to meet them! In these days of keen commercial rivalry and price depression it cannot be expected that producers generally will incur the expense of efforts to improve their materials unless such an improvement is demanded by the inspecting authorities and buyers.

The demand for better melting methods and greater technical control we regard as somewhat hackneyed, and suggest that greater service will be rendered to the industry by a proper appreciation by the engineer and buyer of the technical characteristics of the material.

We cannot agree that modern tendencies are towards reducing the differences between blackheart and whiteheart malleable. The fundamental principles of manufacture are radically different, and any intermediate material loses some of the useful properties of each type.

Finally, any weakening in production of either material will not be due to lack of "modernised production," but to a lack of determination to exploit the potentialities and failure to make known the attributes of the material.

Yours, etc.,

A. E. PEACE,
Convener, Malleable Sub-Committee.

J. W. GARDOM,
Convener, Technical Committee of the I.B.F.

[In thanking our correspondents for their letter, we wish they had devoted more attention to the facts mentioned in the article originally commented on; that eighty tests on malleable bars from eight foundries gave an average elongation of 5.5 per cent., the specification requiring 5 per cent. A national specification for general castings, which can be quoted by any buyer, should be capable of being met by the majority of producers in the trade. Where higher qualities of material are necessary, they should be provided for by additional specifications confined to castings for the specified service requirements.]

King's Birthday Honours

The names of the following gentlemen prominent in the foundry and metallurgical industries appear in the official list of honours conferred by the King on the occasion of his 69th birthday.

SIR HUGO HIRST, BT., chairman and managing director of the General Electric Company, Limited, has been created a Baron.

SIR HUGO HIRST, BT.
(Chairman and Managing Director of the General Electric Company, Limited).

COMMANDER C. W. CRAVEN, O.B.E., R.N. (retd.), managing director of Vickers-Armstrong, Limited, has been Knighted. MR. RONALD W. MATTHEWS, a director of the London & North Eastern Railway Company, Turton Bros. & Matthews, Limited, and General Refractories Company, Limited, has also been Knighted.

SIR ALAN GARRETT ANDERSON, K.B.E., a former president of the Chamber of Shipping, has been promoted to G.B.E.

MR. LOUGHNAN ST. LAWRENCE PENDRED, editor of the "Engineer" and a past-president of the Institute of Mechanical Engineers, has been created a Commander of the British Empire.

Resistance of Austenitic Nickel-Alloy Cast Iron to Sulphur Chloride

According to the "Nickel Cast Iron News" of March, 1934, exposure for a period of 119 days to the action of boiling sulphur chloride produced no loss of weight in a cast iron of the Ni-Resist type, in contrast with a high-grade non-alloy cast iron which lost more than 11 per cent. in weight under identical conditions. The use of the austenitic alloy for mixing kettles handling sulphur chloride has thus the dual advantage of prolonging the life of the apparatus and of ensuring immunity from discoloration and contamination of the product.

Cast-Iron Scrap in the Open-Hearth Furnace

In a Paper read recently by DR. R. HENNECKE before the Verein deutscher Eisenhüttenleute at Berlin, the author discussed the utilisation of iron scrap as a raw material in open-hearth furnace for steel manufacture, and outlined the nature of the metallurgical reactions which took place during the decarburisation period. The iron scrap is charged to the furnace without the addition of either pig-iron or steel scrap, but with excess carbon in suitable form. In this process, certain transformations already take place before the charge is melted, since in addition to the oxidation of the iron by the furnace gases, which is common to all open-hearth processes, the iron oxides are also reduced by the carbon added to the charge in the form of small coke, anthracite or wood charcoal; some of the carbon also penetrates the iron substance. These reduction and cementation processes already commence at a very low temperature and become accelerated with rising temperature, and may, moreover, be very active at temperatures below the melting point if a sufficiently intimate mixture is obtained. First the high-carbon iron melts, and with further rise in temperature also the lower-carbon iron, and finally the residual oxides, unless slag-forming constituents produce a fusion first.

The reactions after incipient melting are similar to a certain degree to those in dealing with pig-iron and ore charges; the concentration of the various components is, however, much lower in the present process, although carbon is still present in the elementary state, even when the charge has melted, thus reducing the oxidising action of the flame. After the carbon has disappeared from the surface of the molten charge, the slag already contains a small proportion of iron, while the manganese content of the steel is very high. From this point the process is identical with other open-hearth reactions. Deoxidation with ferro-manganese employed hitherto is here replaced by simple fusion which ensures the permanent absence of oxides at least during the last hours before tapping. Observations have shown that the manganese content of the charge increases towards the end of the heat and remains sufficiently high to permit tapping without the addition of ferro-manganese. Should such addition be necessary in the manufacture of certain steels, this is done in the ladle after tapping, but merely to raise the manganese content in the steel.

The temperatures of the steel and slag in this decarburisation process are much higher than found by other investigators, and their high level is responsible for the low viscosity of the steel and the slag, even when the latter contains a high proportion of lime, which is necessary to eliminate the sulphur. These high temperatures are obtained by suitable insulation of the furnace and a special design of furnace roof. The process, however, requires a high fuel consumption, and results in marked wear and tear of the furnace, while the hearth and chambers are readily liable to suffer from the impurities in the scrap, *e.g.*, lead and zinc. Yet, if properly carried out and regulated, this process will give a high-grade product, which is an economic consideration where large quantities of iron scrap are available.

Nickel-Cast-Iron Dies

The use of nickel or nickel-chromium cast iron for dies has been one of the outstanding developments in the history of alloy iron. An article in the "Nickel Cast Iron News" of March, 1934, states that the most recently published reference to this application relates to a nickel-chromium die, over which some 200,000 steel beer kegs have been drawn, and which is still in service. The average life of a grey cast-iron die in similar service was 10,000 kegs.

Studies in Cast Bronzes*

By Francis W. Rowe, B.Sc. (Head of Foundries' Laboratories, David Brown and Sons (Huddersfield), Limited)

Despite the fact that the cast bronzes are extensively used in all classes of engineering products, the information and data available concerning them are still lacking in many important particulars. Reliable figures are relatively scarce concerning the precise effect of variations

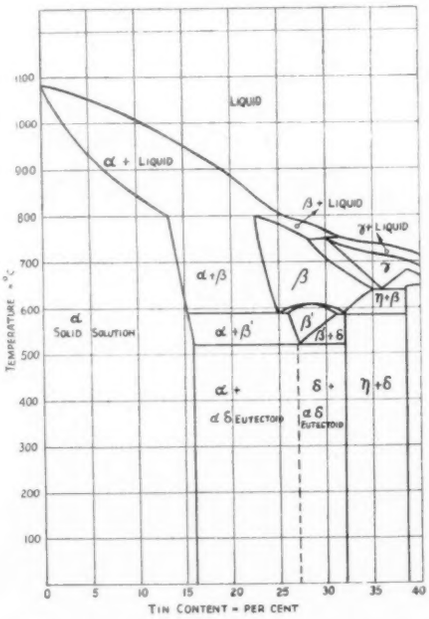


FIG. 1.—EQUILIBRIUM DIAGRAM OF THE SN-CU SERIES OF ALLOYS.

in composition on the physical properties and the effect of mass under various conditions of casting.

The following *résumé* and data have been selected from work by the author as representative of the physical properties obtaining with cast bronzes of various composition and under varying casting temperature and varying mass. They have been selected in an attempt to give a clear working idea of what happens under normal foundry conditions, and the variables have been reduced to the simplest to avoid undue complications.

For casting purposes for engineering use the amount of tin varies from about 5 per cent. to

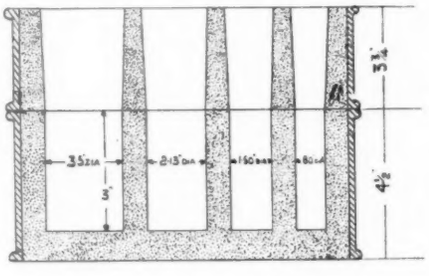


FIG. 3.—METHOD OF MOULDING TEST-BARS.

a maximum of from 15 to 16 per cent. The two other constituents usually present in varying quantities, besides copper, are zinc and lead, and to a lesser extent nickel. Where the cast bronze is needed for anti-frictional or wear-resisting purposes, zinc should be absent, in which case phosphorus is added sometimes purely for deoxidising purposes and sometimes also for increasing the hardness and the anti-frictional and wear-resisting properties. It may be present in quantities varying from 0.3 to 1.4 per cent.

Where the bronze is required for these duties, lead may be added in amounts varying from 1 to 15 per cent. (or in certain specific instances as high as 20 or 30 per cent.) to increase the plasticity of the alloy and increase its fitness for its work in certain conditions. In this particular Paper it is proposed to consider only tin and phosphorus as alloying elements.

Interpretation of Equilibrium Diagram

Whilst a full and detailed knowledge of the copper-tin equilibrium diagram is essential for serious research work, the fact that none of the commercially-used alloys is in the state which would be indicated by the diagram when cast, renders this diagram of no straightforward use to foundrymen.

For instance, the diagram (Fig. 1) indicates that all alloys up to 15 per cent. tin are plain solid solutions of tin in copper. That is, consist entirely of single crystals of homogeneous composition, and, as such, these alloys, like most solid solutions, should be comparatively soft, malleable and ductile, whereas it is known that.

FIG. 2.—ALPHA-DELTA EUTECTOID IN CAST BRONZES.

say, the 15 per cent. tin bronze is relatively hard, brittle and not malleable, either hot or cold.

This is due to the state of the unstable equilibrium in which the cast alloys persist, due to their comparatively rapid rate of cooling after solidification, in commercial foundry practice. In fact, the 15 per cent. tin alloys need several weeks of careful annealing at predetermined temperatures to bring them to a state as indicated on the diagram, *i.e.*, a single solid solution.

Thus it should be fully realised that the diagram does not hold for bronzes between 5 and 15 per cent. tin in the cast state. Nor, unfortunately, could an empirical diagram be drawn showing the make-up in the cast state, as the amount of variation from true equilibrium varies almost entirely with the rate of cooling after solidification, which in turn depends on three variables—mould material, casting temperature and the mass of the casting.

Alpha-Delta Eutectoid

Practically all the cast-bronzes made under normal conditions containing above about 5.5 per cent. tin show the presence of the alpha-delta eutectoid increasing as the quantity of tin rises until at about 28 per cent. tin the whole alloy consists entirely of this constituent.

The alpha-delta eutectoid (a typical patch of which is shown in Fig. 2) is hard and brittle. Its Brinell hardness (3,000 kg.-10 mm. ball) is in the neighbourhood of 400. This is equal in hardness to a 90-ton steel and is commercially unmachinable with ordinary high-speed steels. Its brittleness is such that a piece shatters into a powder with light taps of a hammer. All foundrymen are familiar with the brittleness of 15 per cent. phosphor-copper, and the 28 per cent. tin alloy possesses brittleness of a similar but lesser order.

Thus it will be appreciated that varying quantities (varying with the tin content of the alloy) of this compound materially affect the physical

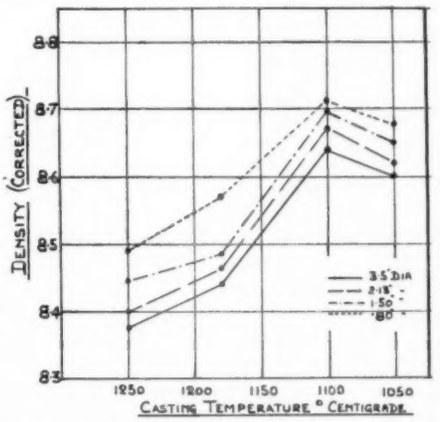


FIG. 4.—DENSITY CURVES FROM SERIES I BARS (7 PER CENT. SN).

properties of the bronzes. Whilst a cast bronze with 7 per cent. tin may have an elongation of 40 to 50 per cent., a 14 per cent. tin bronze rarely shows an elongation of more than 2 per cent. under tensile strain, and is often less than this. Similarly, an impact test-piece (20 mm. by 20 mm. notched to standard B.S.I. proportions) from a cast bronze of 10 per cent. tin requires a blow of 80 to 90 ft.-lbs. to fracture it, whilst one from a bronze of 15 per cent. tin requires only 17 ft.-lbs.

As regards Brinell hardness (1,000-kg. 10-mm. ball), the 7 per cent. tin bronze cast under speci-

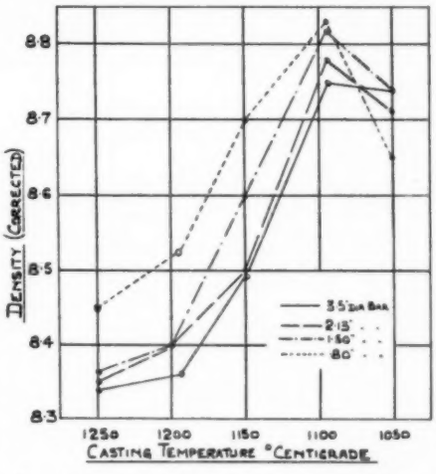


FIG. 5.—DENSITY TESTS ON SERIES II BARS (10.5 PER CENT. SN).

fied conditions has a hardness of 70, whilst the 15 per cent. tin bronze cast under exactly similar conditions has a hardness of 110. These important differences and their effect on the service results are due entirely to the different amounts of this alpha-delta eutectoid present in the

* ▲ Paper read before the Annual Conference of the Institute of British Foundrymen now being held at Manchester.

bronze. Apart from the differences indicated above, due entirely to composition, there then come the large differences which may be present due to casting conditions and mass of the casting.

Experimental Data

To avoid confusion, all variations to melting conditions, gas and oxide content and deleterious impurities have been eliminated in this Paper. Such test results as are quoted are from initially pure metals melted under good average foundry conditions, and the resultant bronzes contain neither more nor less amounts than normally obtain of oxide, gas or deleterious impurities when using virgin raw materials.

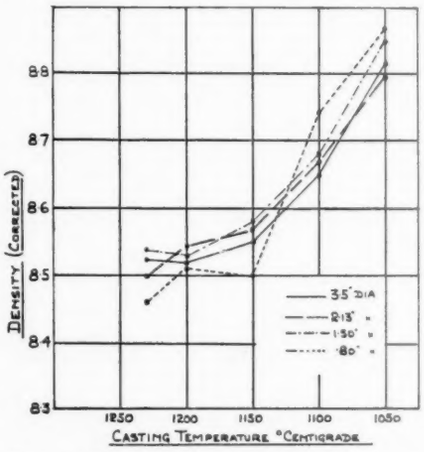


Fig. 6.—Density Tests on Series III Alloy (15.5 per cent. Sn).

The first series given are a 7 per cent. tin bronze containing no other element beyond a slight amount of phosphorus to ensure deoxidation. Actually, an amount equal to 0.1 per cent. was added and 0.04 per cent. was left in the finished castings. From the same pot of metal, six boxes were poured. One box contained a simple ring casting, 8 in. diameter, with $5\frac{1}{4}$-in. bore and $1\frac{1}{4}$ in. deep. Each of the other boxes contained four bars respectively, 0.80 in. diameter (area 0.5 sq. in.), 1.5 in. diameter (approximate area 1.75 sq. in.), 2.125 in. diameter (approximate area 3.5 sq. in.), and 3.3 in. diameter (approximate area 8.5 sq. in.).

All the bars were 3 in. long and placed vertically in the box, and each with a head of $3\frac{3}{4}$ in. long, as shown in the sketch in Fig. 3. These four boxes of bars were cast at 1,250, 1,160, 1,100 and 1,050 deg. C. Thus, these gave the relative effect of both casting temperature and mass. The boxes were dry-sand moulded and dried under specified conditions.

The results of the density tests on this first lot of bars are shown in Fig. 4. The first interesting feature of these curves is that the alloy has followed obvious laws, namely, that rate of solidification, as influenced both by mass and casting temperature, has an appreciable effect on the packing of the grains. The variation in density from the smallest bar to the largest (0.5 sq. in. and 1.75 lbs. wt. to 8.5 sq. in. and 18 lbs.) is, on the average in this series, of 0.12, or about 1.5 per cent. On the other hand, variation in casting temperature from 1,245 to 1,100 deg. C. shows an average variation of 0.25, or 3 per cent. The usual drop in density as the casting temperature approaches the freezing point of the alloy is noticeable. This indicates the precautionary measures necessary in foundry practice if the greatest degree of soundness is to be secured.

In the next series of similar bars cast, the tin content was raised to just over 10 per cent. (the actual analysis being 10.53 per cent.) with a similar small quantity of phosphorus added for deoxidising purposes. Similar casting temperatures were employed and the density results are shown in Fig. 5. Whilst not so regular (due probably to slight departures from the uniformity of conditions) the same trend is observed as in Fig. 4, with the difference that the extended period of solidification, due to the higher tin content of the alloy, has widened the possible variation in density due to difference in casting temperature. With the casting temperature employed, the 7 per cent. tin alloy showed a variation of 0.25 due to casting temperature, but in this series the variation average of 0.40. Just why this should be is not clear, as there is very little difference in the maximum calculated theoretical densities.

In the third composition of alloy used in this series, the tin content was raised to 15.45 per cent., the other conditions being similar.

The density determinations are shown in Fig. 6. Here the same large difference due to casting temperature as was observed in Series II (Fig. 5) is evident, but the difference due to mass is very small. Also due to the same casting temperatures being employed for a lower melting point alloy, the point where the density after rising with falling casting temperature begins to fall again, has not been reached.

The fourth series (Fig.7) was made on an alloy containing 6.37 per cent. of tin and 1.02 per cent. of phosphorus. This showed, as regards density, the well-marked characteristics of the heavily-phosphorised bronzes, namely, extra-

(*Concluded on page* 366.)

Table I.—*Results of Physical Tests on Bars Cut from Test Rings Cast with Various Series of Bars.*

Series.	Composition.		Casting temp. deg. C.	Y.P. tons per sq. in.	M.S. tons per sq. in.	Eln.	Impact.	Brinell 1,000 kg.	Density.
	Tin.	Phosphorus.				Per cent.	20 mm. × 20mm. notched.		
							ft./lb.		
I	7.0	—	1,160	8.2	19.6	36	120 U.B.	69	8.66
II	10.5	—	1,150	12.4	19.8	20	81	83	8.63
III	15.5	—	1,150	—	17.3	1	17	109	8.68
IV	6.4	1.0	1,150	10.0	17.6	14	93	71	8.20
V	10.0	1.0	1,070	13.2	16.6	12	45	87	8.38
VI	14.8	1.0	1,100	—	14.0	1	13	114	8.29

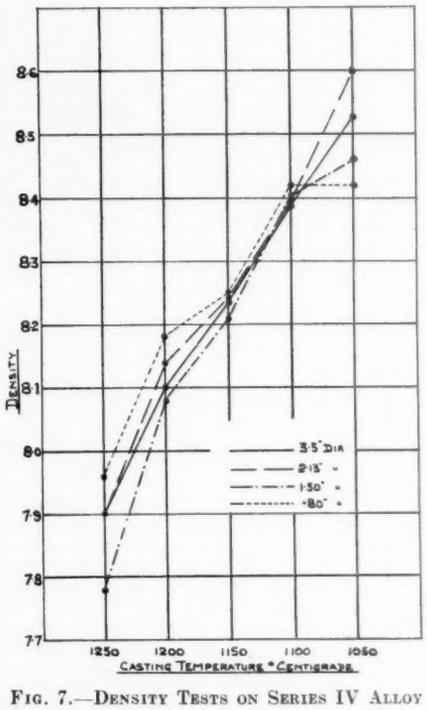


Fig. 7.—Density Tests on Series IV Alloy (6.4 per cent. Sn, 1.0 per cent. P).

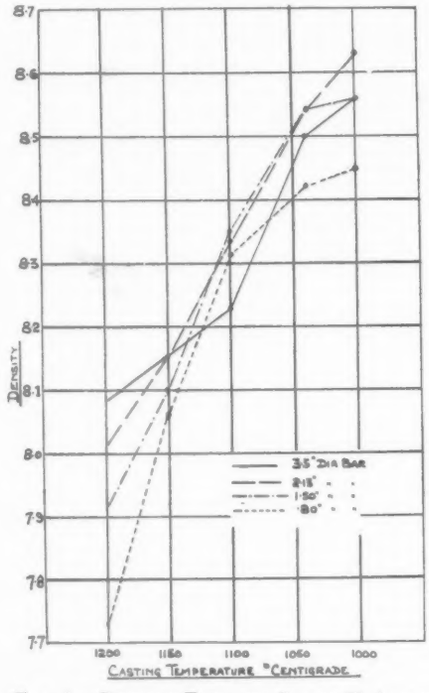


Fig. 8.—Density Tests on Series V Alloy (10.0 per cent. Sn, 1.0 per cent. P).

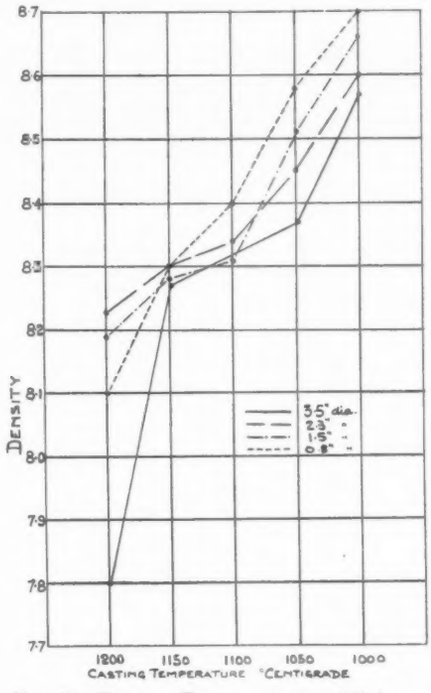


Fig. 9.—Density Tests on Series VI Alloy (14.8 per cent. Sn, 1.0 per cent. P).

OVER HALF A MILLION "SIROCCO" FAN INSTALLATIONS IN WORLD-WIDE SERVICE

···TRADE··· SIROCCO ···MARK···
FANS THE STANDARD OF THE WORLD

"Sirocco" Fan Manufactures include the original "Sirocco" Multibladed Centrifugal Fan; "Sirocco" Centrifugal Fans of the High Efficiency and Backward Bladed Types; "Sirocco" Reversible Belt Driven and Electric Propeller Fans; "Sirocco" Dust Fans; "Sirocco" Hand Driven Fans; "Sirocco" High Pressure and Cupola Fans; "Sirocco" Fans for Mechanical Draft and Mine Ventilation; "Aeroto" Patent Screw Fans.

The fact that over half a million "Sirocco" Fan installations are in WORLD WIDE service emphasizes their pre-eminence for every conceivable industrial requirement involving the movement of air or hot gases in any desired volume and under varied conditions of operation.

Write for "Sirocco Products" which summarises in pictures our manufacturing activities

DAVIDSON & Co LTD.

SIROCCO ENGINEERING WORKS, BELFAST.

BRANCHES:—LONDON, MANCHESTER, GLASGOW, BIRMINGHAM, NEWCASTLE-ON-TYNE, CARDIFF, BRISTOL, DUBLIN.

... universally recognised as the leading brand of Cylinder Pig Iron

WARNER CBR

The way to BETTER castings

WARNER & CO. LTD. CARGO FLEET MIDDLESBROUGH

Studies in Cast Bronzes

(*Concluded from page* 364.)

ordinarily large differences due to variation in period of solidification due to casting temperature. It will be seen on comparing this series of density curves with the previous ones (and particularly with that of a somewhat similar tin-content alloy but without phosphorus—Series I) the marked effect of 1 per cent. of phosphorus. Whilst the average difference in density due to casting temperature in the first series was 0.25, in this series it is 0.6. The lower casting temperature employed, whilst in the smaller bars has had some effect on the progressive rise in density due to falling temperature, has not been sufficiently near the solidus to cause marked unsoundness.

The next series, No. V, were made on an alloy similar to that used in Series II but with 1 per cent. of phosphorus. The tin content was 10 per cent. As the addition of 1 per cent. of phosphorus materially lowers the solidifying point of a 10 per cent. tin alloy, it was felt that the results obtained (Fig. 8) with the same casting temperatures as used for the previous series would give results incomparable with those obtained with this class of alloy, and the maximum and minimum casting temperatures were lowered by 50 deg. C. Its general trend, however, is

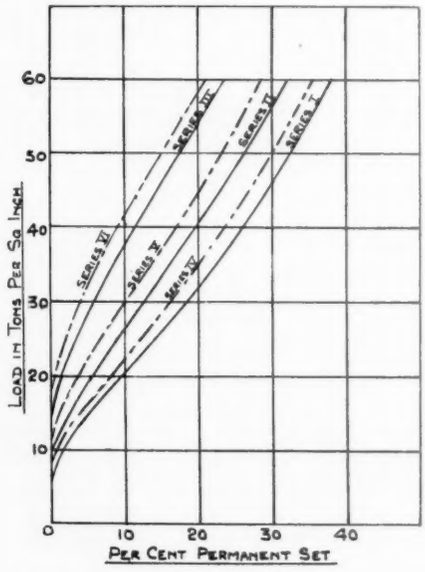


FIG. 10.—CURVES OF COMPRESSION TESTS ON PIECES CUT FROM TEST-RINGS CAST WITH BARS.

similar to that of Fig. 7, but the points appear 50 deg. C. further on the scale. The same wide variation in density with a casting temperature variation of 200 deg. C., as in Fig. 7, is very noticeable.

The next alloy, Series VI, was similar to that used in Series III, but with 1 per cent. phosphorus. The density results are shown in Fig. 9. The tin content was 14.75 and the same range of casting temperatures was used as for Series V.

The same general outline is observable as in the other two series of high-phosphorus alloys, but the very low density of the 3.5-in. dia. bar cast at 1,200 deg. C. is rather inexplicable. It serves, however, to emphasise the sensitivity of this class of alloy and the low density (and soundness) which may follow other than the most rigid standardisation of conditions in the foundry.

Along with these test-bars out of each mixing was cast a test-ring 8 in. dia. with 5.25-in. bore and 1.25 in. wide. The weight of this casting was 11 lbs. and the mould was a normal dry-sand mould run in a conventional manner. From this ring was cut tensile, impact, density and Brinell test-pieces, and the results of these tests are shown in Table I. These are not presented as maxima of which the various alloys are capable, but form an interesting guide when taken in conjunction with the previous graphs of the results to be expected from the various alloys in this range.

It should be specially noted that the impact values obtained are purely empirical, since they are taken on bars 20 mm. square and notched with the usual B.S.I. notches. Higher densities and possibly improved physical properties would probably have been obtained had lower casting temperatures been employed for the alloys Series IV, V or VI.

An interesting illustration on the effect of phosphorus as a hardening agent is shown in Fig. 10, where the results of compression tests on pieces cut from the six sand-cast test-rings from which the tensile figures were obtained.

The author's thanks for permission to present the results of this work are due to his directors at Messrs. David Brown & Sons (Huddersfield), Limited, and to his assistants, by whom these data were collected.

The Ceramic Society

SPRING MEETING AT LLANDUDNO

The Spring Meeting of the Refractory Materials Section of the Ceramic Society was held at Llandudno recently. We append brief summaries of some of the Papers presented.

Permeability of Refractory Materials to Gases

A Paper, the "Permeability of Refractory Materials to Gases," was presented by MESSRS. F. H. CLEWS and A. T. GREEN, and dealt with the influence of the firing process on the permeability to air of fireclay materials. The following is the authors' summary.

(1) The permeability to air of three types of fireclay at stages representing the green to the finished state has been measured, and found to increase continuously up to 1,200 deg. C.

(2) It is concluded that as a result of firing over this range the number of pores decreases, but that their size increases. This is in keeping with the contraction which occurs on firing.

(3) Continued vitrification at temperatures up to 1,400 deg. C. has been found to lead in five instances to an increase in permeability and in five others to a decrease.

(4) It is suggested that vitrification *per se* leads to a decrease in permeability. The observed increases are attributed to the inability of certain types of material to withstand without cracking the strains imposed by vitrification and subsequent cooling.

(5) The low values found for the permeability of dried (120 deg. C.) fireclay emphasise the strains which can be produced by undue haste in the water-smoking period.

(6) The low values for the permeability of the fireclay goods at 650 deg. C. explain the extended time required for complete elimination of carbon from some clays at this temperature.

Some Factors Affecting Furnace Heating Practice

MR. R. J. SARJANT read a Paper on "Some Factors Affecting Furnace Heating Practice," which formed a continuation of previous work by the author. Previous work showed that structure furnace losses due to storage of heat in the refractories forming the furnace structure accounted for roughly a third of the potential heat of the fuel used. In modern furnace practice greater attention should be given to this question of heat storage, with a view to reducing such losses. The author discussed the question at some length, and also the flow of gases in furnaces.

Laws of convection applicable to furnace heating have been established and the needful co-efficients determined for a wide range of problems, and the radiation rate of heat losses from moving gases can be estimated approximately. It has been found that blast-furnace gas, the flame of which was rendered luminous (by addition of benzol) gave off much more radiation than that of a non-luminous flame. The value of mathematical analysis has been proved in connection with the investigation of certain problems which are difficult to deal with by direct experiment. Unfortunately the ready application of mathematical analysis would involve a considerably greater knowledge of higher mathematics than is likely to be available in many cases at present.

Four appendices added to the Paper provide various formulæ, symbols, references, etc.

Basic Refractories for Steel-Melting Furnaces

MESSRS. A. H. B. CROSS and W. J. REES presented a Paper on "Further Investigations of Basic Refractories for Steel Melting Furnaces," which embodied the results of investigations which have extended over four years. The Paper was an exceptionally long one, and considerations of space only permit us to give the more important conclusions.

The reduced burning shrinkage brought about by the addition of kaolin to magnesite—in dead-burned Grecian magnesite/kaolin mixtures—is believed to be due to the formation of minerals of lower specific gravity. A similar effect noticed on adding small quantities of magnesite to kaolin seems to be due to bloating occurring within the briquette.

An expansion noticed on firing some of the mixtures to 1,610 deg. C. after an initial firing of 1,410 deg. C. is ascribed to bloating. Mixtures of interest as refractories contain less than 23 per cent. MgO or more than 44 per cent. MgO. Between 23 and 44 per cent. MgO the mixtures have low refractoriness. When raw Grecian magnesite/kaolin mixtures are used, the general properties resemble those of dead-burned magnesite/kaolin mixtures, but reaction is more complete at lower temperatures, and the burning shrinkage is undesirably high. Pre-calcination of the mixed raw materials seems necessary.

The addition of kaolin to magnesite causes a lowering of the thermal expansion. The spalling tendency of magnesite/kaolin mixtures may be studied by a simple quenching test.

The typical mineral of all mixtures of magnesite and kaolin is cordierite, a double silicate of magnesia and alumina, the proportion of which varies according to the time and temperature of the heat-treatment. Dolomite/kaolin mixtures containing 80 to 95 per cent. dolomite appear interesting as refractories. Addition of kaolin to dolomite has only a slight effect on the burning shrinkage. The use of dolomite calcined at 1,000 deg. C. or replacement of part of the raw dolomite by dead-burned Grecian magnesite causes a definite reduction of the burning shrinkage. Various high dolomite/kaolin mixtures resist hydration by cold water, boiling water, and wet steam very well when fired to 1,560 to 1,610 deg. C. Kaolin additions cause a more rapid under-load failure of dolomite, which is opposite to the effect noted when kaolin was added to magnesite.

Mixtures of dolomite, kaolin, and felspar may show quite good under-load refractoriness.

Internal Chills for Iron Castings

Because of its higher coefficient of expansion, "Ni-Resist" (alloy cast iron containing about 14 per cent. nickel, 6 per cent. copper and 2 per cent. chromium) has been found to provide an important advantage for use as a solid internal chill in iron castings. When employed in this way, the material quickly reaches the approximate temperature of the surrounding metal, before the latter solidifies. Since its expansion is about 50 per cent. greater than that of cast iron, the "Ni-Resist," upon cooling, contracts away from the surrounding metal and may be easily removed even if the chill is not tapered.

XUM

GREAT ECONOMY!

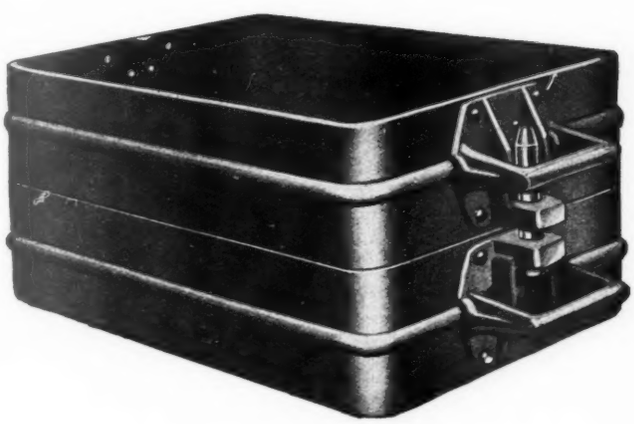
ONE of the greatest improvements you can introduce into your foundry is the STERLING ROLLED STEEL MOULDING BOX.

The result will be economy all round.

Your moulders will put down more moulds per day because STERLING BOXES are light and easy to handle;

You will be sure of an accurate product because STERLING BOXES are accurately made and maintain this accuracy permanently;

Your box maintenance costs will be at least halved because however heavy the service STERLINGS cannot crack or break.



Makers of
MOULDING BOXES
for every
FOUNDRY SERVICE

STERLING FOUNDRY SPECIALTIES LTD.

London Office:
13, VICTORIA STREET, S.W.1.

BEDFORD.

Telephone: 3345 BEDFORD.
Telegrams: "STERFLASK, BEDFORD."
Code: WESTERN UNION.

Glasgow: ALBERT SMITH & CO., 60, ST. ENOCH SQUARE, GLASGOW, C.1.
Newcastle-on-Tyne: PARSON & COLLS, CLARENDON HOUSE, CLAYTON STREET W., NEWCASTLE-ON-TYNE.
Manchester: F. L. HUNT & CO., CHAPEL STREET, SALFORD, MANCHESTER.

This Week's News in Brief

Trade Talk

AN OUTBREAK OF FIRE occurred in the early hours of Saturday at the works of Metal Products Company (Willenhall), Limited, Neachells Lane, Wednesfield, and was extinguished by the Willenhall Fire Brigade.

MESSRS. STEEL BROS. & SONS, LIMITED, have had plans passed for the demolition of property at their Fireclay Enamelling Works, Niddrie, Portobello, to make room for the extension of their glazing, mixing and engineering shops.

MESSRS. EDWARD G. HERBERT, LIMITED, of Atlas Works, Chapel Street, Levenshulme, Manchester, have removed their London office to 20, Dean Street, Westminster, W.1. The telephone number is Temple Bar 2634.

A CONTRACT, which represents a total value of over £200,000, has been secured by the English Electric Company, Limited, Stafford, for the hydraulic generating plant for the three power stations comprising the second stage of the Galloway Hydro-electric scheme.

THE DOCKS AT Grangemouth have been rather more busy during the past week. A cargo of white-iron ore from Oxelsund was amongst the arrivals, and there was a unique cargo, believed to be the first of its kind from Canada, taken in by the "Snefjeld," from Nova Scotia, consisting of nails and coils of wire.

ON SUNDAY NIGHT an outbreak of fire, which was successfully extinguished, occurred at the Phœnix Works, Inchinnan Road, Paisley, of Messrs. Fleming & Ferguson, Limited, engineers and shipbuilders.

THE FIRST CONSIGNMENT of goods from the Leven works of the recently-established firm of Enamelled Metal Products Corporation (1933), Limited, was despatched on Saturday.

MR. WILLIAM F. ANDREW, C.A., Glasgow, has informed the joint secretaries of the Scottish Manufactured Iron Trade Conciliation and Arbitration Board that he has examined the employers' books for March and April, 1934, and certifies that the average net selling price brought out is £9 8s. 10.27d. This means that there will be a reduction of 2½ per cent. in the wages of the workmen.

RUSTON-BUCYRUS, LIMITED, of Lincoln, state that orders in hand include a ¾-yd. petrol shovel for the State Alluvial Diamond Mines, South Africa, a Diesel grabbing crane, with 35-ft. boom and 32/40 cub. ft. grab, to be mounted on a pontoon for digging 35 ft. below water level, and a Diesel grabbing crane with 50-ft. boom and 1¼-yd. grab, mounted on standard caterpillars, for South Africa; and a Diesel dragline with 80-ft. boom and 1¼-yd. bucket, for irrigation work in Australia.

MESSRS. JAMES HOWDEN & COMPANY, LIMITED, Scotland Street, Glasgow, have secured an order for three Howden-Johnson patent air-jacketed improved Scottish boilers, to be installed in one of the two Booth liners building at Birkenhead by Messrs. Cammell, Laird & Company. In view of the economical working of this type of boilers, many inquiries have been received, and one boiler is at the present time under construction by the Wallsend Slipway & Engineering Company, Limited.

THE ANNUAL BUSINESS MEETING of the members of the Denny Iron Works Yearly Benefit Society was held on May 31, Mr. Angus Macdonald presiding. During the year funeral benefit amounted to £38 3s. 5d. A dividend on the 416 shares taken up by members of 1s. 4½d. per share was paid. Office-bearers for next year were elected, including Mr. A. M'Donald as President and Messrs. James Henderson and H. H. M'Combe as secretary and treasurer respectively.

THE GLASGOW CORPORATION has placed with the Skinningrove Iron Company, Limited, an order for 2,250 tons of tram rails. In addition, a smaller order for 260 tons of tram rails has been received from the Leicester Corporation, and the company are now shipping the last consignment of a large order for heavy steel rails for South Africa. Other orders in hand include 2,000 tons of tram rails for the London Passenger Transport Board, whilst the firm is also busy on large rail orders for the L.N.E.R. and L.M.S.

FOLLOWING A CONFERENCE between the employers and the Ironfounding Workers' Association, a strike which had been in progress for more than a week at the Grangemouth Iron Company's Grange Foundry at Falkirk has been brought to a conclusion. The strike was the sequel to the action of the employers in engaging non-union labour to fill the places of men who were withdrawn from the foundry by their union because of failure to reach an agreement regarding the rate of remuneration to be paid for a particular type of pipe-moulding work.

THE ABERDEEN MECHANICAL SOCIETY held their first of the summer excursions on May 26, when a large number of the members travelled to Fraserburgh to inspect the factory of the Consolidated Pneumatic Tool Company, Limited. The plant had been kept running for the benefit of the visitors, and in the various departments pneumatic and electric tools were shown in the different stages of manufacture from the rough to the finished article in operation. Outside the factory were several huge blocks of granite and whinstone, and upon these were demonstrated the rock drills that have established a speed record in the South African gold and diamond mines.

A PARTY OF ABOUT 50 members of the Scottish Branch of the Institute of British Foundrymen accepted the invitation of the directors of the India Tyre & Rubber Company, Limited, to visit the works at Inchinnan on Wednesday, May 30. The party was divided up into groups of four each, in charge of a guide who was familiar with all the details of manufacture, so that each visitor had ample opportunity of gaining information about the various operations from the handling of the raw latex as it entered the works to the finished tyre wrapped ready for despatch. The curing or vulcanising department was perhaps the one in which foundrymen felt most at home, and special interest was taken in the process of moulding the tread designs. Mr. J. Currie, the Branch-President, conveyed the thanks of the Branch to the directors, manager and staff of the company for their respective parts in an enjoyable and instructive visit.

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

Robinson's Boat-Gears, Limited. — Capital £500. Subscriber: C. H. Stacey, 3, Northcote Road, Walthamstow, E.17.

Coxhead's Stratford Foundry, Limited, 15/19, Martin Street, Stratford, London, E.—Capital £1,000. Subscriber: Judith M. Coxhead.

L. Whitwam, Limited, 8 and 10, Crown Street, Acton, London, W.3.—Capital £1,000. Engineers and founders. Directors: L. Whitwam and Marion Hilbert.

Contracts Open

Blackpool.—Electrically-driven centrifugal pumps, for the Town Council. The Borough Surveyor's Office, Blackpool.

Hull, June 13.—20-ton weighbridge, 20 ft. by 8 ft., for the Town Council. Mr. T. Douglas, director of public cleansing, Guildhall, Hull.

Saffron Walden, June 14.—Centrifugal borehole pump, for the Town Council. Mr. A. H. Forbes, borough engineer, 3, Hill Street, Saffron Walden. (Fee £1, returnable.)

South Africa, July 23.—15,000 kw. steam turbo-generator, condensing plant, etc., for the Johannesburg City Council. The Department of Overseas Trade. (Reference A.Y. 12,394.)

Billinge, June 12.—Electrical-driven borehole pump and accessories, 600 yds. of 6 in. dia. cast-iron pipes, etc., for the Billinge and Winstanley Urban District Council. The Surveyor, Council Offices, Billinge, near Wigan.

London, E.C., June 20.—Six electrically-driven vertical centrifugal pumps, piping, valves and other works at Green Lanes Pumping Station, Stoke Newington, London, N.4, for the Metropolitan Water Board. The Offices of the Board, Chief Engineer's Department, 173, Rosebery Avenue, E.C.1.

Personal

MR. FRANK WAIN, of the Britannia Tube Company, Limited, has been elected to the board of management of the Birmingham section of the 1935 British Industries Fair.

MR. L. TIBBENHAM, managing director of the Suffolk Iron Foundry (1920), Limited, Stowmarket, is personally presenting a Paper to the International Congress of Oxy-Acetylene Industries at Rome, this week, on the subject of "Welding Rods for Cast Iron."

MR. J. WORTLEY FAWCETT, Dr. W. H. Hatfield, and Mr. Arthur Matthews have been elected directors of Messrs. Thos. Firth & John Brown, Limited, Sheffield. They were formerly local directors. Mr. Fawcett has been manager of the Tinsley works. Dr. Hatfield, who holds the Bessemer gold medal, has had charge of the Brown-Firth research laboratory for many years, and is Director of Technical Research. Mr. Matthews is the manager of the Atlas and Norfolk Works.

Will

POTTER, ARCHIBALD SAMUEL, ironfounder, 207, Nithsdale Road, Glasgow ... £9,620

Obituary

MR. M. L. F. GIRARDET, President of the French *Association Technique de Fonderie*, has been bereaved by the sudden death of his son, Mr. Jean Girardet, graduate of the *Ecole Supérieure de Fonderie*. Mr. Jean Girardet managed his father's foundry at Saint Dié (Vosges).

MR. H. R. MURRAY-PHILIPSON, M.P. for Twickenham, Middlesex, who died last week in a London nursing home, was a director of the Manvers Main Collieries, Limited, and chairman of the North Eastern Marine Engineering Company, Limited. He was elected for the Twickenham Division two years ago. Mr. Murray-Philipson was 32 years of age.

MR. ROBERT STEVEN RUSSELL, who died in London on May 30, was a native of Hamilton, and had been employed with the British Oxygen Company as a demonstrator in electric welding. He served his apprenticeship at the Steel Company of Scotland's Newton steelworks, and for some time afterwards was employed by the Fairfield Shipbuilding & Engineering Company, Limited, transferring later to the British Oxygen Company, Limited.

Publication Received

Crucible Furnaces. Publication No. NDF4, reissued by The Morgan Crucible Company, Limited, of Battersea Works, London, S.W.11.

This publication contains a mass of technical data of very real interest to foundrymen. The metals covered include non-ferrous alloys, steel and cast iron, and this last material when alloyed with expensive alloys for making austenitic cast iron is demanding more extensively the use of the crucible process. What we like about this work is that the issuing house has had the courage to give exactly the time and coke consumption for many metals and alloys. This does make comparisons with competitive processes an easy matter. The crucible furnace, because of its elasticity in the domain of process conduct, will never be superseded. It possesses a great metallurgical advantage in that it has a deep bath and presents a minimum area for reaction with atmosphere. One of the most interesting sections is that dealing with the various classes of coke available for crucible melting. We think that such valuable data as exist in this pamphlet are worthy of a rather more artistic binding. The present green one is a little unworthy of the highly interesting contents. We strongly advise our readers to procure a copy of this catalogue for careful perusal and filing.

XUM

THIS DESK PAD TELLS A STORY

JUNE 5.

"Balfron" Arriving. Full Cargo.
Grangemouth. Med and S.

JUNE 6.

TWO GOOD THINGS
DERBY. WINDSOR LAD.
ERITH. LOAM.

JUNE 7.

Load 200 Tons, Boston, U.S.A. S.

JUST ORDINARY DAYS AT ERITH.

●

MED. stands for MEDIUM.
S. ,, ,, STRONG.

●

Ships, Railway Wagons, Lorries, all Busy. Every day. Delivering at Home and Abroad PARISH'S ERITH LOAM.

Prices and Samples from :

J. PARISH & CO., Loam Quarries, ERITH, KENT.

Produce your own Foundry Blacking.

Better quality at a fraction of the usual cost.

BRITISH REMA

Ring Roll pulverising plant for grinding coal and coke to fine powder.

Dry mixers for mixing coal, coke, china clay, silica, graphite, or other materials in the dry state.

Centrifugal wet mixing machines for producing the finest blacking wash.

Other* BRITISH REMA *Specialities :—

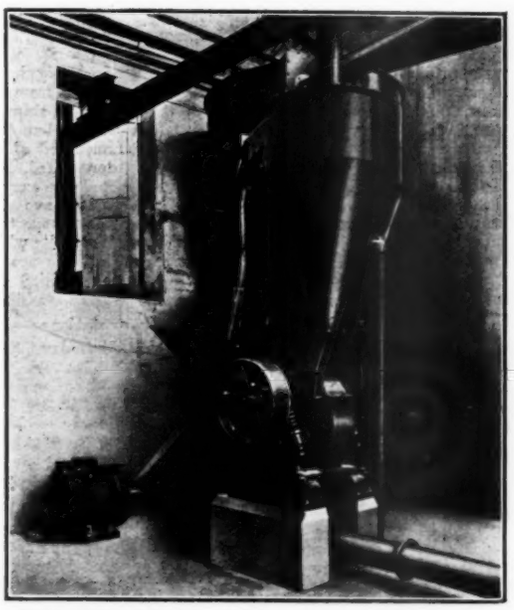
Ball Mills, Sand Aerators, Core Breakers.

Pulverised Fuel Firing Plant for melting furnaces, annealing ovens, etc.

Send for Catalogues.

The British Rema Mfg. Co., Ltd.,
Hubert Street Works, Halifax.

LONDON REPRESENTATIVE :
P. G. Ryder, First Avenue House, High Holborn, W.C.1.



British Rema R.W. 65 Coal Pulverising Plant.

Automatically feeds, dries, grinds, classifies and discharges ground coal into bin in one operation.

XUM

Raw Material Markets

The home demand for iron and steel has recently slowed down a trifle, but this is only to be expected at a period of the year when stock-taking operations are to the fore; confidence in the future of the market is undiminished. Producers of pig-iron have a good amount of work on hand, and deliveries to consumers are maintained on a satisfactory scale. A number of pig-iron contracts come to an end this month, and there should shortly be some activity in connection with renewals.

Pig-Iron

MIDDLESBROUGH.—Local consumption of Cleveland pig-iron remains heavy, and, with a strong Scottish demand to satisfy, there is little or no surplus left for export. Actually, there is little overseas business to be had at the moment, even at specially-reduced prices. Deliveries of Cleveland iron last month are estimated to have been above the average for the earlier months of the year. There has been no alteration in the fixed zone prices.

There is a substantial demand for East Coast hematite from Sheffield and the Midlands, in addition to heavy local consumption, but some decline in business with South Wales and the Continent has occurred. There are now ten furnaces in blast here on hematite. The makers are rigidly adhering to the fixed zone prices, which for No. 1 quality are 68s. per ton delivered Middlesbrough, 70s. delivered North-East Coast, 75s. Glasgow, 76s. Lancashire and 79s. at Birmingham. Quotations for mixed numbers are 6d. per ton less than for No. 1 quality.

LANCASHIRE.—Apart from one or two renewals of contracts for Midlands iron, business in this area has been on the slow side lately, but increased buying should be seen within the next few weeks. Quotations are generally steady. For delivery to Lancashire users, with the exception of those in the Widnes district, where the basis rate is still 72s. 6d. per ton, Staffordshire, Derbyshire and North-East Coast No. 3 are all quoted at 74s. per ton, with Northamptonshire at 72s. 6d., West Coast hematite at about 80s. 6d. and East Coast at 76s. for No. 1 and 75s. for No. 3 unbroken, and 2s. more for broken. Scottish ironmasters are doing no more than a very quiet trade in this district, but at 82s. 6d. to 83s. per ton, delivered equal to Manchester, for No. 3 material, values are practically unchanged.

MIDLANDS.—Consumption of pig-iron in this district has been well maintained, the May deliveries being very satisfactory. Indications of improving trade continue to be noticeable in the general engineering trade. A meeting of the Central Pig-Iron Producers' Association was held last week, when it was decided to make no change in the prices of Midland irons. The present figures applying to Birmingham and Black Country stations are 67s. 6d. per ton for Northants No. 3 and 71s. for Derbyshire, Staffordshire and Lincolnshire No. 3, subject to small graduated rebates for large consumers. There are no changes in the prices of irons suitable for the engineering trade; Scottish iron is round about 85s. to 87s. 6d., with other low-phosphorus iron from 82s. 6d. to 87s. 6d., and medium-phosphorus 70s. to 80s. per ton delivered Midland stations. For special work where refined iron to guaranteed analysis is requisitioned, prices range from £5 15s. to £6 15s. delivered.

SCOTLAND.—The demand for Scottish foundry iron is very poor. Quotations remain at the official minimum of 70s. per ton, f.o.r. furnaces, for No. 3, with 2s. 6d. per ton extra for No. 1. The Falkirk light-castings industry continues to be very busy, and there is an undiminished demand for Cleveland iron, which is quoted at 67s. 3d. per ton f.o.r. Falkirk for No. 3, and 70s. 3d. per ton f.o.r. Glasgow. Other English irons are obtainable at slightly less.

Coke

The strength of the foundry-coke market is maintained. Makers are well booked as far as September, and in some cases to the end of the year. Quotations for delivery in the South Staffordshire area are as follow:—Best Durham coke, 38s. 6d. to 40s.; other grades, 35s. to 36s.; Welsh coke, 37s. 6d. to 45s.; Scottish coke, 41s. to 42s.

Steel

Although business continues rather quiet, it is regarded as being a seasonal movement, and is causing no concern to the makers, as nearly all departments of the steelworks are busily employed upon orders in hand, states the official report of the London Iron and Steel Exchange. In the semi-finished steel department, the demand is rather quiet, but many of the larger consumers appear to be working upon contracts placed some time ago, and for the time being are showing little interest in the market. The producing works, however, are well employed, and have satisfactory order-books. Competition in the home market from the Continent is still a factor of the position, but although the prices are below the British works' quotations, comparatively little business appears to have gone abroad. Conditions are satisfactory in all finished-steel departments, although the demand is not so insistent as it was a few weeks ago. The heavy-steel works are still turning out quantities of ship-building material, and the demand for steel from the engineering trade has improved.

Scrap

Cast-iron scrap prices in the Cleveland market, which were increased a week or so ago, maintain their firm tone. Current quotations are 52s. 6d. for ordinary heavy iron and 55s. for heavy machinery metal. Light metal has also a firmer tendency, and 47s. 6d. per ton is now the bottom price. Market conditions are unchanged in the Midlands, prices remaining at 55s. for heavy machinery metal in handy sizes, 50s. for good heavy, and 47s. 6d. for clean light scrap, all delivered works. There is only a moderate demand for heavy cast iron in South Wales, at about 47s. 6d. per ton, cast-iron machinery scrap also being quiet at 51s. 6d. to 52s. In the Scottish market, machinery cast-iron scrap, in pieces not exceeding 1 cwt., is unchanged at 55s. to 56s., with ordinary cast iron to the same specification at 52s. 6d. to 53s.

Metals

Copper.—Quotations on the London market have recently been depressed by offerings of cheap electro, largely resulting from selling pressure by the American producers. Consumption in this country remains at a fairly steady level. A feature of the copper trade lately has been the increased demand for copper sheets from the Indian market, supplies of sheets for early shipment being now considerably restricted. The ban imposed by Germany on purchases from abroad of refined and electrolytic copper has now been raised, but trade with that country is still restricted by exchange difficulties. More optimistic reports have been received from America regarding the prospects of the copper market under the new "code," which has just been put into operation, but the prospect of a severe strike in the U.S. steel and allied industries has to be reckoned with.

Daily quotations :—

Cash.—Thursday, £32 12s. 6d. to £32 13s. 9d.; Friday, £32 13s. 9d. to £32 15s.; Monday, £32 5s. to £32 6s. 3d.; Tuesday, £32 6s. 3d. to £32 7s. 6d.; Wednesday, £32 8s. 9d. to £32 10s.

Three Months.—Thursday, £32 18s. 9d. to £33; Friday, £33 to £33 1s. 3d.; Monday, £32 11s. 3d. to £32 12s. 6d.; Tuesday, £32 11s. 3d. to £32 12s. 6d.; Wednesday, £32 15s. to £32 16s. 3d.

Tin.—Statistics published last Friday, relating to tin production and consumption during May, showed a reduction in the total visible supplies of roughly 1,200 tons. A meeting of the International Tin Committee was held on June 5, when it was decided to proceed with the "buffer pool" scheme.

Consumption is on the whole well maintained, but new buying has been on a rather reduced scale, operators adopting a cautious attitude, having in view the unsettled conditions which still prevail in America; a moderate business is reported in this country and on the Continent. Fundamental conditions meanwhile show little important change. The market continues to display a firm undertone and, as some improvement in demand on the part of consumers may be expected after the recent slackening in this direction, it seems likely that the present level of prices will at least be maintained, and, indeed, a moderate advance would probably be experienced were the present unsettlement to be dispelled, state Messrs. Rudolf Wolff & Company in their weekly report.

Market prices :—

Cash.—Thursday, £232 15s. to £232 17s. 6d.; Friday, £231 2s. 6d. to £231 7s. 6d.; Monday, £229 to £229 5s.; Tuesday, £228 to £228 2s. 6d.; Wednesday, £228 5s. to £228 10s.

Three Months.—Thursday, £229 10s. to £229 15s.; Friday, £228 10s. to £228 15s.; Monday, £226 5s. to £226 10s.; Tuesday, £225 15s. to £225 17s. 6d.; Wednesday, £226 2s. 6d. to £226 5s.

Spelter.—The spelter market has failed to show any definite improvement. Satisfactory quantities of high-grade metal are being absorbed by the brass mills, but there is still no sign of any upturn in the galvanising trade. Similar conditions prevail in the United States.

Day-by-day prices :—

Ordinary.—Thursday, £14 17s. 6d.; Friday, £14 16s. 3d.; Monday, £14 13s. 9d.; Tuesday, £14 11s. 3d.; Wednesday, £14 13s. 9d.

Lead.—The market has had a dull tone during the past week. World stocks of lead have been showing a downward tendency during recent months, but the process of recovery, if continued, will apparently be very protracted.

"The arrivals of Empire metal have recently been hardly sufficient to cover consumption in England, and some quantities of duty-free metal have been delivered from warehouse. Consequently the tariff question has again been under discussion by some manufacturers, who wish to be assured of an ample supply of Empire metal without having to pay for warehousing costs. They are unable, owing to the tariff, to purchase foreign metal which is arriving, while the Government has so far derived no revenue from the imposition of the duty," report Messrs. Brandeis, Goldschmidt.

Market fluctuations :—

Soft Foreign (Prompt).—Thursday, £11 3s. 9d.; Friday, £11 2s. 6d.; Monday, £10 17s. 6d.; Tuesday, £11; Wednesday, £11 2s. 6d.

Studies on Cast Red Brass for the Establishment of a Basic Classification of Non-Ferrous Ingot Metals for Specification Purposes

(*Continued from page* 361)

There was observed, however, in the determination of the linear shrinkage of the solid metal, a definite expansion at a temperature just below the solidus. This is shown in Fig. 9 by the portion of the curve H—B. To determine whether or not this expansion was the result of "gassing" of the metal from the charcoal which formed a part of the protecting covering used in the ordinary procedure, charges were melted in the induction furnace, and in a gas-fired furnace with a protective covering of fused sodium carbonate. The same phenomenon was observed in all cases, for remelted metal as well as for virgin metal. These results are given in Fig. 10. The cause and significance of this behaviour are still uncertain.

Running properties.—The running properties were determined on both virgin and remelted metal with the results shown in Fig. 11. The remelted metal, cast in green sand, was more fluid than virgin metal cast under the same condition.

REFERENCES.

1 The alloy is referred to in this Paper as "Red Brass 85-5-5-5."

2 Standard Specifications for Composition Brass or Ounce Metal Sand Castings (A.S.T.M. Designation B62-28), "A.S.T.M. Standards," Part I, Metals, p. 678, 1930.

3 R. W. Parsons, Deep Etching of Brass Applied to Gating Problems. "Trans. Am. Fdymen's Assoc.," Vol. 39, p. 843, 1931.

4 C. M. Saeger, jr., and E. J. Ash, A Method for Determining the Volume Changes occurring in Metals during Casting. Res. Paper No. 399, "Bureau of Standards Jour. of Research," Vol. 8, No. 1, p. 37, 1932.

5 C. M. Saeger, jr., and A. I. Krynitsky, A Practical Method for Studying the Running Quality of a Metal Cast in Foundry Moulds. "Trans. Am. Fdymen's Assoc.," Vol. 39, p. 513, 1931.

6 Made by Dr. J. L. Thomas, Associate Physicist, Bureau of Standards.

7 Standard Method of Test for Resistivity of Metallic Materials for Resistors (A.S.T.M. Designation: B63-29), "Am. Soc. Test. Mats. Standards," Part I, Metals, p. 869, 1930.

(*To be concluded.*)

GENUINE COLD BLAST PIG IRON

In addition to their renowned chilling properties, and their great resistance to wear and to growth under heat, our COLD BLAST PIG IRONS are noted for their

Our Cold Blast Pig Irons are Genuine All-mine Blast Furnace Products.

GREAT STRENGTH *and* TOUGHNESS

YOU PAY A LITTLE MORE FOR *GENUINE* COLD BLAST PIG IRON, BUT YOU MAKE UP FOR IT IN THE GREATLY IMPROVED QUALITY OF YOUR CASTINGS.

THE EARL OF DUDLEY'S ROUND OAK WORKS, LTD.,
BRIERLEY HILL, STAFFS.
Brand: "DUD·L.N.F'ces·DUD"

M. & W. GRAZEBROOK,
LIMITED,
DUDLEY, WORCS.
Brand: "GRAZEBROOK"

THE LOW MOOR IRON
CO., LTD.,
NEW WORKS, LOW MOOR,
BRADFORD - YORKSHIRE.
Brand: "LOWMOOR C.B."

MAKERS OF GENUINE COLD BLAST PIG IRON

RAW MATERIALS—PRICE LIST

(Wednesday, June 6, 1934)

COPPER

	£	s.	d.
Standard cash	32	8	9
Three months	32	15	0
Electrolytic	35	12	6
Tough	34	10	0
Best selected	35	0	0
Sheets	62	0	0
India	44	0	0
Wire bars	35	15	0
Ingot bars	35	15	0
H.C. wire rods	38	10	0
Off. av. cash, May	32	14	$0\frac{9}{21}$
Do., 3 mths., May	32	19	$2\frac{6}{11}$
Do., Sttlmnt., May	32	13	$11\frac{6}{11}$
Do., Electro, May	35	19	$2\frac{5}{11}$
Do., B.S., May	35	16	$11\frac{1}{2}$
Do., wire bars, May	36	3	$3\frac{6}{11}$
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			$6\frac{1}{2}$d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	$8\frac{3}{4}$d.
Rods, extd. or rlld.	$4\frac{1}{4}$d.
Sheets to 10 w.g.	$7\frac{1}{4}$d.
Wire	$7\frac{3}{4}$d.
Rolled metal	7d.
Yellow metal rods	$4\frac{1}{2}$d.
Do. 4 × 4 Squares	$5\frac{3}{4}$d.
Do. 4 × 3 Sheets	$5\frac{3}{4}$d.

TIN

	£	s.	d.
Standard cash	228	5	0
Three months	226	2	6
English	228	15	0
Bars	229	15	0
Straits (nom.)	228	12	6
Australian (nom.)			—
Eastern	228	0	0
Banca (nom.)			—
Off. av. cash, May	234	7	$8\frac{1}{21}$
Do., 3 mths., May	231	1	$6\frac{9}{21}$
Do., Sttlmt., May	234	7	6

SPELTER

	£	s.	d.
Ordinary	14	13	9
Remelted	14	15	0
Hard	12	2	6
Electro 99.9	17	5	0
English	15	5	0
India	14	2	6
Zinc dust	17	0	0
Zinc ashes	3	5	0
Off. aver., May	14	16	$10\frac{1}{2}$
Aver. spot, May	14	14	$5\frac{5}{11}$

LEAD

	£	s.	d.
Soft foreign ppt.	11	2	6
Empire (nom.)	11	12	6
English	12	15	0
Off. average, May	11	3	$11\frac{1}{2}$
Average spot, May	11	1	$0\frac{5}{11}$

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	10	0
Do., V.M. ex whse.	22	17	6
Rods	28	15	0

ANTIMONY

	£	s.	d.		£	s.	d.
English	42	0	0	to	43	0	0
Chinese, ex-whse.					33	10	0
Crude					24	10	0

QUICKSILVER

	£	s.	d.		£	s.	d.
Quicksilver	11	0	0	to	11	7	6

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	£8 17 6
45/50%	£13 0 0
75%	£18 2 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	3/3 lb.
Tungsten metal powder—	
98/99%	3/6 lb.
Ferro-chrome—	
2/4% car.	£32 0 0
4/6% car.	£23 0 0
6/8% car.	£21 12 6
8/10% car.	£21 12 6
Ferro-chrome—	
Max. 2% car.	£36 0 0
Max. 1% car.	£38 15 0
Max. 0.70% car.	£42 0 0
70%, carbon-free	10d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£180 0 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under $\frac{1}{2}$ in. to $\frac{1}{4}$ in.	3d. lb.
Do., under $\frac{1}{4}$ in. to $\frac{1}{16}$ in.	1/- lb.
Flats, $\frac{1}{2}$ in. × $\frac{1}{4}$ in. to under 1 in. × $\frac{1}{8}$ in.	3d. lb.
Do., under $\frac{1}{2}$ in. × $\frac{1}{4}$ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.
Bars cut to length, 10% extra.	

SCRAP

South Wales—	£	s.	d.		£	s.	d.
Heavy steel					2	15	0
Bundled steel and shrngs.	2	2	6	to	2	7	6
Mixed iron and steel	2	8	0	to	2	10	0
Heavy cast iron	2	7	0	to	2	8	0
Good machinery	2	11	6	to	2	12	0
Cleveland—							
Heavy steel					2	10	0
Steel turnings					1	17	6
Cast-iron borings					1	7	6
Heavy forge					2	10	0
W.I. piling scrap					2	5	0
Cast-iron scrap	2	12	6	to	2	15	0
Midlands—							
Light cast-iron scrap					2	7	6
Heavy wrought iron					3	0	0
Steel turnings, f.o.r.					1	13	0
Scotland—							
Heavy steel					2	10	0
Ordinary cast iron	2	12	6	to	2	13	0
Engineers' turnings					2	0	0
Cast-iron borings					1	19	6
Wrought-iron piling	2	10	0	to	2	11	3
Heavy machinery	2	15	0	to	2	16	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	26	0	0
Brass	19	0	0
Lead (less usual draft)	10	0	0
Tea lead	7	10	0
Zinc	9	10	0
New aluminium cuttings	69	0	0
Braziery copper	23	0	0
Gunmetal	24	10	0
Hollow pewter	155	0	0
Shaped black pewter	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	57/6
„ at Falkirk	67/3
„ at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
„ d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
„ No. 3 fdry.	71/-
Northants forge	63/6
„ fdry. No. 3	67/6
„ fdry. No. 1	70/6
Derbyshire forge	67/-
„ fdry. No. 3	71/-
„ fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
„ No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
„ fdry. No. 3	68/6
Lincs forge	64/6
„ fdry. No. 3	68/6
E.C. hematite	80/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.		£	s.	d.
Bars (cr.)	9	12	6	to	9	15	0
Nut and bolt iron	7	10	0	to	8	0	0
Hoops	10	10	0	to	12	0	0
Marked bars (Staffs) f.o.t.					12	0	0
Gas strip	10	10	0	to	12	0	0
Bolts and nuts, $\frac{3}{4}$ in. × 4 in.	14	0	0				
Steel—							
Plates, ship, etc.	8	15	0	to	8	17	6
Boiler plts.	8	2	6	to	8	10	0
Chequer plts.					10	7	6
Angles					8	7	6
Tees					9	7	6
Joists					8	15	0
Rounds and squares, 3 in. to 5$\frac{1}{2}$ in.					9	7	6
Rounds under 3 in. to $\frac{1}{4}$ in. (Untested)					8	12	0
Flats—8 in. wide and over					8	12	6
„ under 8 in. and over 5 in.					8	17	6
Rails, heavy	8	5	0	to	8	10	0
Fishplates	12	5	0	to	12	10	0
Hoops (Staffs)					9	7	0
Black sheets, 24g. (4-t. lots)					10	10	0
Galv. cor. shts. („)					13	0	0
Galv. flat shts. („)					13	10	0
Galv. fencing wire, 8g. plain					14	10	0
Billets, soft					5	10	0
Billets, hard	6	17	6	to	7	2	6
Sheet bars	5	0	0	to	5	5	0
Tin bars					5	0	0

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	12d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	17.50
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	38.00
	Cents.
Iron bars, Phila.	1.94
Steel bars	1.90
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.25
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
„ furnace	20/-
Durham foundry	21/- to 25/-
„ furnace	17/6
Midlands, foundry	—
„ furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	17/3 to 17/6
„	28×20 „	34/6 to 35/-
„	20×10 „	24/9 to 25/-
„	18¾×14 „	18/- to 18/3
C.W.	20×14 „	15/6
„	28×20 „	32/3 to 32/6
„	20×10 „	22/- to 22/1½
„	18¾×14 „	15/6 to 15/7½

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£6	0	0	to	£7	0	0
Bars-hammered, basis	£16	0	0	to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0	to	£16	0	0
Blooms	£10	0	0	to	£12	0	0
Keg steel	£30	0	0	to	£31	0	0
Faggot steel	£18	0	0	to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0	to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£ s. d.	
May	31 ..	32 12 6	inc. 2/6
June	1 ..	32 13 9	„ 1/3
„	4 ..	32 5 0	dec. 8/9
„	5 ..	32 6 3	inc. 1/3
„	6 ..	32 8 9	„ 2/6

Electrolytic Copper

		£ s. d.	
May	31 ..	36 0 0	No change
June	1 ..	36 0 0	„ „
„	4 ..	35 12 6	dec. 7/6
„	5 ..	35 12 6	No change
„	6 ..	35 12 6	„ „

Standard Tin (cash)

		£ s. d.		
May	31 ..	232 15 0	inc.	5/-
June	1 ..	231 2 6	dec.	32/6
„	4 ..	229 0 0	„	42/6
„	5 ..	228 0 0	„	20/-
„	6 ..	228 5 0	inc.	5/-

Tin (English ingots)

		£ s. d.		
May	31 ..	233 5 0	inc.	5/-
June	1 ..	231 15 0	dec.	30/-
„	4 ..	229 15 0	„	40/-
„	5 ..	228 10 0	„	25/-
„	6 ..	228 15 0	inc.	5/-

Spelter (ordinary)

		£ s. d.		
May	31 ..	14 17 6	inc.	1/3
June	1 ..	14 16 3	dec.	1/3
„	4 ..	14 13 9	„	2/6
„	5 ..	14 11 3	„	2/6
„	6 ..	14 13 9	inc.	2/6

Spelter (Electro, 99.9 per cent.)

		£ s. d.		
May	31 ..	17 8 9	inc.	1/3
June	1 ..	17 10 0	„	1/3
„	4 ..	17 7 6	dec.	2/6
„	5 ..	17 5 0	„	2/6
„	6 ..	17 5 0	No change	

Zinc Sheets (English)

		£ s. d.	
May	31 ..	23 10 0	No change
June	1 ..	23 10 0	„ „
„	4 ..	23 10 0	„ „
„	5 ..	23 10 0	„ „
„	6 ..	23 10 0	„ „

Lead (English)

		£ s. d.	
May	31 ..	12 10 0	No change
June	1 ..	12 10 0	„ „
„	4 ..	12 10 0	„ „
„	5 ..	12 10 0	„ „
„	6 ..	12 15 0	inc. 5/-

AVERAGE MONTHLY PRICES OF DERBYSHIRE NO. 3 FOUNDRY AT MANCHESTER.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898	2 7 6	2 8 0	2 8 0	2 8 0	2 8 6	2 10 0	2 10 0	2 10 0	2 10 0	2 11 0	2 14 0	2 14 0	2 9 11
1899	2 13 0	2 14 0	2 14 0	2 14 0	3 0 0	3 2 0	3 13 0	3 16 6	3 15 0	3 16 6	3 16 6	4 0 0	3 6 2½
1900	4 0 0	4 0 0	4 0 0	4 1 6	4 1 0	3 18 0	3 13 6	3 12 6	3 11 0	3 11 0	3 9 6	3 8 0	3 15 5
1901	2 13 6	2 17 0	2 15 0	2 15 0	2 14 0	2 13 9	2 13 6	2 13 6	2 14 6	2 13 0	2 12 6	2 16 6	2 14 3½
1902	2 17 6	2 17 6	2 15 6	2 16 9	2 16 6	2 16 6	2 16 6	2 17 0	2 18 6	2 18 6	2 17 6	2 17 6	2 17 1½
1903	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1904	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6	2 17 6
1905	2 13 0	2 13 0	2 11 6	2 12 6	2 12 0	2 12 0	2 12 3	2 12 3	2 14 0	2 16 6	3 0 0	3 0 6	2 14 1
1906	3 2 0	3 5 0	3 3 0	3 0 6	2 17 0	2 18 6	2 18 0	2 16 6	2 19 0	3 0 6	3 1 6	3 7 0	3 0 8½
1907	3 7 0	3 7 0	3 5 0	3 2 0	3 4 0	3 8 0	3 6 0	3 5 0	3 4 0	3 2 6	3 1 0	2 18 6	3 4 2
1908	2 15 0	2 14 6	2 14 6	2 15 6	2 14 0	2 13 0	2 13 0	2 11 6	2 12 6	2 13 0	2 12	2 12 6	2 13 5½
1909	2 13 0	2 12 6	2 11 6	2 12 0	2 12 6	2 12 6	2 12 0	2 12 6	2 14 6	2 15 0	2 14 6	2 14 0	2 13 0½
1910	2 13 9	2 14 0	2 14 0	2 14 4	2 15 0	2 15 0	2 14 9	2 15 0	2 15 0	2 15 0	2 15 0	2 15 0	2 14 7½
1911	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 16 0	2 14 6	2 16 0	2 15 0	2 15 8½
1912	2 17 4½	2 17 6	2 17 6	3 1 1½	3 2 6	3 3 9	3 6 3	3 7 6	3 10 10½	3 12 6	3 13 3½	3 14 6	3 5 4
1913	3 15 7	3 15 0	3 11 10½	3 11 4½	3 10 2½	3 6 10½	3 4 2½	3 2 9	3 1 9	3 1 0	2 19 3	2 17 2½	3 6 5
1914	2 17 2½	2 18 0	2 18 0	2 17 0	2 17 0	2 16 7½	2 16 0	3 2 10	3 1 0	2 19 9½	2 16 11½	2 18 1½	2 18 2
1915	3 1 2	3 3 11	3 5 9	3 18 8½	3 13 7	3 14 1	3 15 0	3 13 3	3 12 0½	3 11 1	3 14 0	4 3 3	3 12 2½
1916	4 4 6½	4 11 6	4 11 6½	4 7 6	4 7 6	4 7 6	4 10 0	4 12 10	4 12 6	4 12 6	4 12 6	4 12 6	4 8 6½
1917	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1918	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6	4 12 6
1919	4 12 6	4 12 6	4 12 6	4 12 6	7 2 6	7 5 0	8 8 5	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	7 3 10
1920	9 13 9	10 0 0	10 5 3	10 15 3	11 10 0	12 2 6	12 5 0	13 1 3	14 7 6	14 5 0	14 5 0	14 5 0	12 12 1½
1921	12 11 8	10 8 9	9 2 6	8 2 0	8 0 0	8 0 0	8 0 0	8 1 8	7 4 0	6 7 6	5 7 6	4 10 10	8 0 2
1922	5 5 0	4 17 6	4 15 0	4 15 0	4 12 6	4 12 6	4 12 6	4 12 6	4 11 3	4 10 0	4 10 0	4 10 0	4 13 7½
1923	4 12 8½	5 0 2	6 2 6	6 8 7½	6 2 5	5 11 9	5 9 1½	5 4 0	5 0 0	5 0 9	5 0 7	5 2 9	5 7 11½
1924	5 3 0	5 3 0	5 3 0	5 3 0	5 2 10	5 1 3	4 17 11	4 15 6	4 13 6	4 10 1½	*	4 10 3	4 17 9½
1925	4 10 0	4 9 0	4 6 9	4 5 2½	4 3 0	4 0 1½	4 17 1½	3 15 7½	3 14 3½	3 13 4½	*	3 13 2½	4 1 9
1926	3 14 9	3 15 3	3 15 6	3 15 3½	3 17 6	4 5 9	4 16 9	*	*	*	*	4 12 6	4 0 1½
1927	4 13 9½	4 13 3	4 11 1½	4 9 4½	4 6 1½	3 19 1½	3 16 1½	3 15 6	3 13 4½	3 13 4½	3 14 0	3 13 6½	4 1 6½
1928	3 13 2½	3 12 3½	3 12 3	3 12 3	3 11 6	3 10 0	3 8 3	3 7 8½	3 7 6	3 7 9½	3 8 3	3 7 6	3 9 10½
1929	3 8 3½	3 10 4½	3 10 10½	3 11 0	3 11 2½	3 12 0	3 12 4½	3 14 6	3 15 1½	3 17 0	3 17 0	3 17 0	3 13 1½
1930	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 17 0	3 15 0	3 12 0	3 12 0	3 12 0	3 10 1½	3 9 6	3 14 4½
1931	3 9 6	3 9 6	3 9 6	3 9 6	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 10
1932	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1933	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0	3 7 0
1934	3 7 0	3 9 6	3 13 2½	3 14 0	3 14 0	—	—	—	—	—	—	—	—

* No prices available during strike period.

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK
CUMPET

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.
ZETLAND ROAD, MIDDLESBROUGH.

Notice

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-
(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

ROLL Foundry Manager (life experience), possessing full technical and practical qualifications, is now at liberty.—Full particulars will be sent on application to Box 768, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

REPRESENTATIVES required throughout Great Britain for master guaranteed process for permanently protecting and/or colouring aluminium to any desired shade. Commission basis only.—Write, Box 895, DORLAND, 14, Regent Street, S.W.1.

WANTED, Foundry Foreman in Midlands with experience in light castings, rainwater goods, ranges, grates, etc.; must be capable of handling 3 400 men, and have a special knowledge of the best cupola practice and able to get results. Good wages will be paid to a suitable man. Age not over 35. Replies must state fully experience and wages. Information will be treated in strict confidence. —Box 776, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

EXPERIENCED Foundry Foreman desires position. General engineering, jobbing, machine-moulding. Experienced in estimating, cupola practice, etc. (245)

YOUNG Foundry Foreman in charge of grey-iron, non-ferrous, malleable foundry, desires change. Willing to go abroad. (246)

BUSINESSES FOR SALE AND WANTED

ADVERTISERS wish to acquire an Ironfoundry, near London, capable of producing 50/75 tons medium-weight castings per week.—Price and full particulars to be addressed to Box 778, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

OLD-ESTABLISHED Ironfoundry for Sale owing to death; going concern, well connected, full up with orders; competent staff, good buildings; freehold, 1¼ acres.—Box 770, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATENT

THE Proprietors of British Patent No. 299,489 are prepared to grant a non-exclusive licence to British manufacturers to work thereunder. It relates to a machine for casting non-ferrous metals.—Address, BOULT, WADE & TENNANT, 112, Hatton Garden, London, E.C.1.

MACHINERY

STEEL CASTING PLANT.

"STOCK" Oil-fired Converter Plant, 1 ton capacity, with Blower, Economiser and Equipment; first-class self-contained plant for small steel castings; no cupola needed. £250.

A. HAMMOND, Foundry Machinery Merchant, 14, Australia Road, Slough.

ONE genuine Tabor Roll-over Shockless Jolt-ram MOULDING MACHINE to take 30-in. by 40 in. boxes; practically new; can be seen working. Price £120.

One Roll-over Shockless Tabor JOLTING MACHINE to take 60 in. x 48 in.; can be seen working. Price £160.

A. HAMMOND, 14, Australia Road, Slough.

SAND-BLAST PLANTS AND AIR COMPRESSORS

(Tilghman's).

We have in stock :—
11 NEW SAND-BLAST PLANTS.
14 Re-conditioned Sand-blast Plants.
90 NEW AIR COMPRESSORS.
15 Re-conditioned Air Compressors.
All sizes—all pressures.

Sand-blasting and Metal-spraying for all Trades.

R. J. RICHARDSON & SONS, LTD.,
COMMERCIAL STREET, BIRMINGHAM, 1.

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.
Rotoil "Senior" Oil Core Sand Mixer.
Pneulec Sand Drying Plant, output 1 ton per hour.
Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.
Also
Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.
Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

AIR COMPRESSORS

All sizes for high and low pressures.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.

Hori. Treble Ram PUMP, 7½" dia. rams, 6" str., motor-dr.
16" cen. B.G., S.S. and Sc. LATHE, admit 15' 0" between cens.
Port. Electric DRILLING MACHINES, ⅝" cap., 15' 0" cable.
VERT. COCHRAN BOILER, 14' x 7', 100 lbs. w.p.
STEEL WIRE ROPES for Winding Hawsers, etc., in stock.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MISCELLANEOUS

FLUIDITY TESTS as described in THE FOUNDRY TRADE JOURNAL, February 1, 1934. Patterns of the above in aluminium can be supplied for 35s. per set. Post free. We can also supply Patterns for all branches of the engineering trade, in hard or soft woods. Send us your inquiries.—FURMSTON & LAWLOR, Patternmakers, Letchworth, Herts.

TIME RECORDERS (workpeople); guaranteed; must clear.—Box 734, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MISCELLANEOUS—*Continued*

WANTED, Pattern Equipment for the manufacture of rainwater goods, namely, gutters, downpipes, and connections.—Box 774, Offices of THE FOUNDRY TRADE JOURNAL, 49 Wellington Street, Strand, London, W.C.2.

GOOD-QUALITY Cast-iron Scrap wanted. State price and quality, delivered free on trucks.—Box 780, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

STEEL SCRAP, consists of melted-down safety-razor blades; about 50 tons for quick sale.—J. C. MACKINLAY & COMPANY, 27, Walbrook, London, E.C.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1934 edition now ready. Price 42s. cloth bound, 52s. morocco. Order *YOUR* copy *NOW*.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 287 SLOUGH

SANDBLAST PLANTS

12' × 9' Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories **£290 Nett.**

T.B. 1 Tilghman sandblast barrel plant, complete. CHEAP.

T.B. 3 Tilghman sandblast barrel plant, double-jet, complete. CHEAP.

6' "Jackman" rotary sandblast table. CHEAP seen working.

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1 **£30**
Pneumatic riddle, by Macdonald **£8**
Large "Baillott" sand preparing plant CHEAP.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun, and on occasions—be it admitted—of naughtiness. Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception. Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.
Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.
There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.
Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.
Here's a suggestion. Your eyesight is worth 3d. a year to you. Send Peter and his handicapped pals 3d. for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,
SCHOOL FOR THE BLIND
(FOUNDED 1838)
SWISS COTTAGE, LONDON, N.W.3